### SELECTED

# **SWATER**RESOURCES ABSTRACTS



VOLUME 14, NUMBER 17 SEPTEMBER 1, 1981

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## SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the Office of Water Research and Technology, U.S. Department of the Interior

VOLUME 14, NUMBER 17 SEPTEMBER 1, 1981

W81-03601 -- W81-03950





The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

#### **PREFACE**

Semimonthly journal, includes abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology U.S. Department of the Interior Washington, D.C. 20240

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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#### SELECTED WATER RESOURCES ABSTRACTS

#### 1. NATURE OF WATER

#### 1B. Aqueous Solutions and Suspensions

THE PREDICTION OF MINERAL SOLUBILITIES IN NATURAL WATERS: THE NA-K-MG-CA-CL-SO4-H2O SYSTEM FROM ZERO TO HIGH CONCENTRATION AT 25C,

California Univ., San Diego, La Jolla. Dept. of Chemistry.

C. E. Harvie, and J. H. Weare. Geochimica et Cosmochimica Acta, Vol 44, No 7, p 981-997, 1980. 7 Fig. 5 Tab, 56 Ref.

Descriptors: \*Solubility, \*Saline water, \*Chemical precipitation, Calcium compounds, Sodium compounds, Potassium compounds, Magnesium compounds, Chlorides, Sulfates, Minerals, Model studies, Brines, Equilibrium, Phase diagrams, Thermodynamics, Algorithms.

A chemical model was developed for predicting mineral solubilities in seawater systems from zero to high concentrations. The Pitzer equations were found to accurately model mineral solubilities for the system Na-K-Mg-Ca-Cl-SO4-H2O, but the extended Debye-Huckel and Wood (1975) models had limited applicability. Parameters for this model were defined by data from binary and ternary systems. The third virial coefficients were essential for predicting thermodynamic properties at high systems. The third virial coefficients were essential for predicting thermodynamic properties at high concentrations. Calculated results were within experimental error of solubility measurements. This method can be used to model systems with an arbitrary number of possible non-ideal solution phases. In evaporation of seawater to form salt deposits, most models eliminate the Ca and carbonate ions for simplication. Using the model described in this paper, Ca removal was not necessary. A mineral sequence predicted from the model varied from previous predictions and more closely resembled the sequence observed in the Zechstein resembled the sequence observed in the Zechstein deposit in Germany. (Cassar-FRC)

#### 2. WATER CYCLE

#### 2A. General

WATER RECOVERY SYSTEM.

J. C. Taylor.

U.S. Patent No 4,214,454, 9 p, 3 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 996, No 5, p 1613, July 29, 1980.

Descriptors: \*Patents, \*Water sources, \*Water types, \*Water vapor, Precipable water, Heat transfer, Equipment, Refrigeration, \*Atmospheric

An apparatus for transforming the water vapor in the atmosphere into liquid water comprises a pre-cipitating chamber, a mixing chamber, heat trans-fer system and means for moving atmospheric air through the system. The method comprises the steps of passing a first stream of air past a heat absorbing element of a heat transfer system to absorbing element of a heat transfer system to cause water to precipitate onto the heat absorbing element of a heat transfer system to cause water to precipitate onto the heat absorbing element; mixing the first air stream with a second air stream; passing the mixed air streams past the heat dissipating element of the heat transfer system; varying the proportion of amount of all from the first and second air streams to a predetermined ratio which is a function of the atmospheric conditions. (Sinha-DEIS) W81-03691

A STOCHASTIC MODEL FOR DAILY STREAMFLOW,
Grupo ELECTROBRAS, Rio de Janeiro (Brazil).

For primary bibliographic entry see Field 2E W81-03710

LAND-USE HYDROLOGY: SHOALHAVEN, NEW SOUTH WALES, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Plant Industry.

Industry. A. R. Aston, and F. X. Dunin. Journal of Hydrology, Vol 48, No1/2, p 71-87, August, 1980. 4 Fig, 5 Tab, 16 Ref.

Descriptors: "Model studies, "Streamflow, "Land use, Pastures, Forests, Vegetation, Hydrology, "Australia, Alteration of flow, Rainfall-runoff relationships, Simulation analysis, Synthetic hydrology, New South Wales.

ogy, New South Wales.

A computer model simulated the results of changes in land use on streamflow for the upper Shoalhaven Valley, New South Wales, Australia. Presently land in the 7,300 km sq catchment is used as follows: forest, 50% (half on steep slopes not likely to be developed); natural pasture, 30%; improved pasture, 15%; and intensive agriculture, 2%. Simulations of extreme changes in land use in 2 catchments during a year with average rainfall (1973) and a year with high rainfall (1974) showed varying reductions of streamflow with conversions of native to improved pasture, native woodlands to pine plantations, and pastures to pine plantations. The greatest changes in stream-flow occurred with reductions of 29 mm (in 1973) and 226 mm (1974) for the conversion of pasture to pines over 49% of the area. Changes in land use produced less significant streamflow reductions in wet years than in average years. (Cassar-FRC)

MULTIPLE-VALUED AND NON-CONVERGENT SOLUTIONS IN KINEMATIC CASCADE

MODELS, Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering. T. E. Croley, II, and B. Hunt. Journal of Hydrology, Vol 49, No 1/2, p 121-138, January, 1981. 5 Fig, 27 Ref.

Descriptors: \*Kinetics, \*Mathematical studies, \*Rainfall-runoff relationships, \*Overland flow, Flow, Kinematic cascade models, Hydrographs, Runoff, Hydrology, Watersheds, Shocks.

The Lax-Wendroff finite-difference solution of equations of motion using the kinematic flow ap-proximation, widely applied in hydrology to cas-cade models of overland flow, can produce problems due to the complexity of contemporary model inputs. The adequacy of finite-difference solutions or the existence of kinematic shocks resulting from or the existence of kinematic shocks resulting from the mathematics, as seen by intersecting characteristics in the method of characteristics in the method of characteristic solution, may not be detected by previously employed criteria. A method is devised for locating the point along a cascade segment when the solution first becomes multiple-valued, for the lateral inflow situation. If the shocks are not physically relevant, the kinematic flow method approximation must not be used. The effect of anomalies may be multiplied to produce large errors in the composite hydrograph. duce large errors in the composite hydrograph from the cascade. (Cassar-FRC) W81-03718

DELIMITATION OF NEW ZEALAND HYDRO-LOGIC REGIONS, Forest Research Inst., Christchurch (New Zea-

Forest Landy:
M.P. Mosley.
Journal of Hydrology, Vol 49, No 1/2, p 173-192,
January, 1981. 7 Fig, 2 Tab, 14 Ref.

Descriptors: \*Regional analysis, \*Hydrology, \*Hydrologic data. \*Flood forecasting. Cluster analysis, Watersheds(Basins), Climatic data, Statistical methods, Synthetic hydrology, \*New Zealand,

Cluster analysis of flood hydrological data was Cluster analysis of 11000 nydrological uata was partially successful in identifying New Zealand catchments with similar hydrological regimes. In the South Island, four major regions were defined, differing mainly in climate (lithology and topogra-phy differences were not significant). The North Island, a complex mosaic of hydrologically similar

areas, could not be divided into broad regions because no single factor was dominant in controlling hydrologic regimes. Regionalization can produce some difficulties, such as assigning a catchment that straddles a boundary line to the 'correct' region. In cases similar to the North Island, uncertainties introduced by regionalization may outweigh apparent benefits. Cluster analysis cannot eliminate subjective decisions but can aid in interpreting data from physically similar (but not in close geographic proximity) regions. (Cassar-FRC) W81-03719

THE PERFORMANCE OF A MODIFIED CO-SHOCTON-TYPE RUNOFF SAMPLER, Agricultural Extension Service, Stillwater, OK. Water Conservation Structures Lab.

C. E. Rice, and W. R. Gwinn.
Transactions of the ASAE, Vol 24, No 1, p 134138, January-February, 1981. 8 Fig, 4 Ref.

Descriptors: \*Measuring instruments, \*Runoff, Sampling, Water sampling, Monitoring, \*Water quality, Runoff volume, \*Erosion, Sediment transport, Soil Ioss.

The procedure, analysis, and results of tests performed with a modified N-2 Coshocton-type runoff sampler under different approach conditions are outlined. A comparison is made between the performance of this sampler and the standard design sampler performance. The observed head-discharge relationships are compared with the standard rating table and a rating developed by Gwinn and Parsons. Modifications and their effects no sampler performance are discussed. While it Gwinn and Parsons. Modifications and their effects on sampler performance are discussed. While it was found that the N-2 Coshocton-type runoff sampler will operate satisfactorily within the design capacity, the turning of the sampling wheel was irregular, and occasionally it would stall momentarily just before the sampling head moved under the water jet. Even within design limits the approach conditions to the H flume tended to cause accelerated flows through the H flume. This significantly affected the H flume discharge, with differences as large as 50% between the observed discharges and the standard rating. (Baker-FRC) W81-03760

CALIBRATING THE USDAHL HYDROLOGIC MODEL ON GRASSLAND WATERSHEDS, Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Bengtson, F. R. Crow, and A. D. Nicks.
Transactions of the ASAE, Vol 23, No 6, p 1473-1480, November/December, 1980. 11 Fig. 7 Tab, O Ref.

Descriptors: "Model studies, "Watersheds(Basins), "Runoff, "Grasslands, Calibrations, "Hydrology, Mathematical studies, Simulation analysis, Oklahoma, Evapotranspiration, Groundwater recharge.

The USDAHL model, which is a continuous simu-Ine USDATL model, which is a continuous simulation parametric hydrological model, was calibrated on a gaged 6.3 ha grassland watershed (Guthrie W-V) in Oklahoma by three methods. Of the three types of calibration tried, Type II proved best, with parameter values as follows: vegetative, 0.6, depression stages, 1.27 mm; ratio of maximum evadepression stages, 1.27 mm; ratio of maximum eva-portanspiration to maximum pan evaporation for a year, 0.88; and deep groundwater recharge, 0.0229 mm per hour. When applied to the 7.8 ha Chicka-sha R-7 grassland watershed 79 km southeast of the Guthrie plot, the model predicted runoff with an error of 1.7%. (Cassar-FRC) W81-03769

DYNAMICS OF RURAL NONPOINT SOURCE WATER QUALITY IN A SOUTHEASTERN WATERSHED,

North Carolina State Univ., at Raleigh. Dept. of Agricultural Engineering. L. F. Bliven, F. J. Humenik, F. A. Koehler, and

M. R. Overcash.

Transactions of the ASAE, Vol 23, No 6, p 1450-1456, November/December, 1980. 5 Fig. 5 Tab, 15

#### Group 2A-General

Descriptors: \*Rainfall-runoff relationships, \*Water quality, \*Nonpoint pollution sources, \*Watersheds(Basins), Land use, Agriculture, Runoff, Path of pollutants, Surface waters, Base flow, Streamflow, Water pollution sources, \*Chowan River, Piedmont, Channels, Nutrients, North Carolling.

Four differing rural sites in the Chowan River watershed in North Carolina were surveyed for a year for runoff and transport of chemical constituents, COD, TOC, total P, total Kjeldahl N, nitral N, and chloride. Of two sites in the Piedmont, one was 90% forested, the other 35% crop and pasture land. Two similar coastal plain agricultural subbasins were studied to assess differences between unchannelized and channelized stream quality. Surface runoff concentrations of chemical constituents were only marginally greater than base flow concentrations except for the unchannelized coastal plain site. The forested and agricultural Piedmont areas differed in a peak P concentration 3 times normal, which occurred after spring planting in the agricultural site. At all sites chloride concentra-tions in surface waters were less than base flow concentrations. Channelization caused greater chemical concentrations in runoff, with maximum nitrate-N more than 10 times greater during winter when water yield was only 2-fold greater. (Cassar-FRC) W81-03774

#### 2B. Precipitation

THE ESTIMATION AND DISTRIBUTION OF STORM MOVEMENT AND STORM STRUCTURE, USING A CORRELATION ANALYSIS TECHNIQUE AND RAIN-GAUGE DATA, University of the West Indies, St. Augustine (Trinidad). Dept. of Mathematics.

R. J. Marshall. Journal of Hydrology, Vol 48, No 1/2, p 19-39, August, 1980. 17 Fig, 18 Ref.

Descriptors: \*Storm structure, \*Precipitation, Surface velocity, Rainfall, Winds, Correlation analysis, Contours, Weather patterns, England, Mathematical studies, Rain gauges, Gauging stations, Storm movement, \*Rainfall distribution.

Speed and direction of movement of storm rainfall Speed and direction of movement of storm rainfall patterns is estimated using data from a network of continuously recording rain gauges. Cross-correlations are made between all pairs of gauges for different time lags, giving not only an estimate of storm motion, but an indication of temporal and spatial structure. For example, bands of rainfall show ridge-like correlation surfaces, and storms with no definite spatial structures yield rounded correlation surfaces, contours. Association of 20 correlation surface contours. Analysis of 219 storms at Cardington and Winchcombe, England, storms at Cardington and Winchcombe, England, showed little difference in patterns between the two stations. The prevailing direction was 240 on the compass, and the average storm speed 41 km per hour, with storms from the southwest moving fastest. Average storm pattern duration was 20-26 minutes. Storm orientation was related to the storm orientation was related to the storm orientation was solved to the storm orientation and the storm orientation and the storm orientation and the storm orientation and the storm of the storm orientation and the storm orientation are storm or storm orientation and the storm orientation are storm orientation and the storm orientation and the storm orientation are storm orientation and the storm orientation are storm orientation and the storm orientation and the storm orientation are storm orientation and the storm orientation are storm orientation. and 700-mbar wind directions, the minor axis lying 26 degrees to storm direction and 45 degrees to 700-mbar wind direction. At Cardinaton these to 700-mbar wind direction. 700-mbar wind direction. At Cardington there was no preferred orientation, but at Winchcombe the storms lay with the larger axis parallel to the Cotswold escarpment. (Cassar-FRC) W81-03716

SKILL IN PRECIPITATION FORECASTING IN THE NATIONAL WEATHER SERVICE, National Weather Service, Silver Spring, MD. Techniques Development Lab. J. P. Charba, and W. H. Klein. Bulletin of the American Meteorological Society, Vol 61, No 12, p 1546-1555, December, 1980. 11 Fig. 1 Tab, 28 Ref.

Descriptors: \*Weather forecasting, \*Precipitation(Atmospheric), Meteorology, Forecasting, Weather data.

This study considers the long-term performance of different types of precipitation forecasts produced in the National Weather Service. The largest upward trends in skill were noted in the area of local probability of precipitation forecasts for periods of 24-36 hr and 36-48 hr. Improvement, alods of 24-36 hr and 36-48 hr. Improvement, ai-though not as great, was also noted in the area of predictability for the 12-24 hr period. Most of the noted improvement occurred from 1970 to the present, and is attributed to improvements in nu-merical and statistical centralized guidance fore-casts. During the cool season the skill and accuracosts. Duting the cool resonant accuracy of both measurable and quantitative precipitation forecasts is 35-55% greater than during the warm season. The secular rate of improvement of warm season. The secular rate of improvement of the cool season precipitation forecasts is 50-110% greater than that of the warm season. This differ-ence between the seasons reflects the relative differ-culty of forecasting the predominantly stratiform precipitation of the cool season and the convective precipitation of the warm season. (Baker-FRC) W81-03838

A DEPTH-DURATION-FREQUENCY DIA-GRAM FOR POINT RAINFALL IN SWA-NA-MIBIA,

MIBIA, University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit. W. V. Pitman. Water SA, Vol. 6, No 4, p 157-162, October, 1980.

5 Fig. 3 Tab. 4 Ref.

Descriptors: \*Probable maximum precipitation, \*Depth-area-duration analysis, \*Africa, Mathematical studies, Precipitation intensity, Rainfall intensity, Isohyets, Local precipitation, Rain gauges,

An isohyetal map of SWA-Namibia has been com-piled from data resulting from a study of available daily rainfall of the area. A co-axial diagram was also devised from which the maximum likely oneday precipitation could be estimated provided that the mean annual precipitation at a location is stated for a given recurrence interval. The co-axial diagram was extrapolated to cover storm durations as short as 6 sec by utilizing relationships between short-duration and 24-hr rainfalls as calculated from data at nine autographic gauges in the study location. Comparison of results with data from a recent study of South Africa indicated that ex-treme rainfalls in SWA-Namibia as well as other arid sections of Southern Africa might be much higher than predicted by earlier research. (Geiger-FRC) W81-03926

#### 2C. Snow, Ice, and Frost

PERFORMANCE ASSESSMENTS OF PRECIPITATION GAGES FOR SNOW MEASURE-

Wyoming Univ., Laramie, Water Resouces Re-For primary bibliographic entry see Field 7B. W81-03727

#### 2D. Evaporation and Transpiration

FIELD MEASUREMENT OF SEEPAGE AND EVAPOTRANSPIRATION RATE FOR A SOIL UNDER PLANT COVER: A COMPARISON OF SOIL WATER BALANCE AND TRITIUM LABELING PROCEDURE,

BELING PROCEDURE, Forstliche Forschungsanstalt, Munich (Germany, F.R.). Inst. fuer Bodenkunde. K. Kreutzer, O. Strebel, and M. Renger. Journal of Hydrology, Vol 48, No 1/2, p 137-146, August, 1980. 2 Tab, 5 Fig, 11 Ref.

Descriptors: \*Seepage, \*Evapotranspiration, \*Soil water, \*Radioactive tracers, Infiltration, Loess, Field tests, Flow, Seasonal variation, Roots, Tracers, Wheat, Beets, Forests, Time series analysis,

Vertical water flux at a depth of 90 cm and evap transpiration were measured in a loss soil profile, under spring wheat and sugar beets during a 21 month period. Two field methods were compared: use of a tritiated water tracer followed by core sampling, and the soil water balance method. Results of the two methods agreed well except during the growing season. Differences in the results were related to differences in sampling in the two methods. The 90 cm depth used in the first method included the root zone of the crops, whereas the 60 cm depth of sampling in the water balance method was not affected by water withdrawals caused by plant roots. Correction to account for root zone activity produced reasonable agreement between the two methods. (Titus-FRC)

RELATIVE RATES OF EVAPORATIVE WATER LOSSES FROM OPEN AND VEGETATION COVERED WATER BODIES, Science and Education Administration, Phoenix, AZ. Water Conservation Lab.

No. 1, p 46-48, February, 1981. 21 Ref.

Descriptors: \*Evaporation, \*Lakes, Water conservation, Aquatic plants, Temperature, Water loss, Vegetation effects, Water depth, Solar radiation.

The effect of vegetation on the surface evaporation in bodies of water was considered in a literature review, including experimental and theoretical material. Compared with open water containing no vegetation, large vegetated lakes (ily pads, rushes, trees, water hyacinths, etc.) lose less water to evaporation, and small vegetated lakes lose more. The more robust the plant growth, the more ware evaporation, and small vegetated takes lose more. The more robust the plant growth, the more evaporative loss occurs. In very clear, deep lakes, summer evaporation may be slower because the water is cooler on the surface than in a lake full of vegetation, where much of the solar radiation is concentrated at the surface. (Cassar-FRC) W81-03781

THE DISTRIBUTION OF PLANT WATER STRESS AND VEGETATION CHARACTERISTICS IN SOUTHERN CALIFORNIA CHAPAR-

NAL, San Diego State Univ., CA. D. K. Poole, and P. C. Miller. American Midland Naturalist, Vol 105, No 1, p 32-43, January, 1981. 5 Fig, 2 Tab, 22 Ref.

Descriptors: \*Chaparral, \*Shrubs, \*Drought, Water stress, Forest fires, Transpiration ratio, Arid lands, \*California.

The hypothesis that the characteristic summer drought in Southern California starts at the coast and begins progressively later with distance from the coast was tested. The xylem pressure potentials of chaparral shrubs along a transect from the coast through the mountains to the desert were measured during two summer dry periods. Various shrub characteristics that might be affected by the availability of water during leaf development were also measured. Water stress and shrub characteristics that might be affected by the solution of the company of the stress and shrub characteristics. tics were related to the distribution of chaparral. Results suggest another hypothesis: that as chaparral regrows after fire, the foliage area increases and the potential transpiration decreases until the trans the potential transpiration decreases until the transpiration per leaf area is reduced to 150-200 mm/year, unless the canopy is severely light or nutrient limited. This implies that the leaf-area index develops until the length of the drought is similar throughout the range of chaparral. California chaparral consists of evergreen sclerophyllous shrubs. (Small-FRC) W81-03847

#### 2E. Streamflow and Runoff

ROCK TYPE AND MINIMUM 7-DAY/10-YEAR

Patton, Harris, Rust and Guy, Bridgewater, VA. R. W. Smith.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215675, Price codes: A04 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Bulletin 116, April, 1981. 43 p, 11 Fig, 15 Tab, 15 Ref. OWRT-A-999-VA(23). Descriptors: \*Groundwater movement, Minimum flow, \*Streamflow forecasting, Wastewater facilities, \*Virginia, Rock properties, Available water, Groundwater runoff, Groundwater, Streamflow, Flow, Streambeds, Flow rates, \*Base flow, Flow resistance, Flow system, Forecasting, Streams, Geologic formations, \*Geohydrology, Drainage

The purpose of this study was to demonstrate an effective method of minimum 7-day/10-year flow (Q) estimation in order to assist proper construction of sewage treatment plants or to estimate safe surface water withdrawals for water systems. A direct comparable relationship was noted between the geologic rock categories studied and their disthe geologic rock categories studied and their discharge rate during low flow periods as approximated by Q. Streams flowing through unconsolidated sedimentary material, Triassic sandstone, shale and sandstone interbeds, or metavolcanic rock do not have high yields for their drainage area size; those flowing through metamorphosed sedimentary and igneous rock, Lynchburg conglomerates, and carbonate rock show markedly high flow values relative to their basin size. Springs greatly influence Q stream flow through carbonate rock. Q values can be estimated for streams with dissimilar rock types by addition of streamflows for each rock type within the stream drainage area. Gauge stations should be constructed for metavolcanic and Triassic sandstone rock streams so that further information on minimum 7-day/10-year flow can be developed. (Zielinskiday/10-year flow can be developed. (Zielinski-IPA) W81-03609

STOCHASTIC MODEL FOR DAILY A STOCHAST STREAMFLOW

Grupo ELECTROBRAS, Rio de Janeiro (Brazil).

J. Kelman. Journal of Hydrology, Vol 47, No 3/4, p 235-249, July, 1980. 3 Tab, 7 Fig, 3 Ref.

Descriptors: \*Stochastic hydrology, \*Flow measurement, \*Streams, Mathematical models, Effecsurement, Sureans, Mathematical moders, Effective storage, Hydrographs, Precipitation, Surface water, Runoff, \*Streamflow, Storage capacity, Reservoirs, Rivers, Watersheds, Model studies, Channels, Flow, Groundwater storage.

A model for the description and generation of A model for the description and generation of samples for daily streamflow is developed. The basic assumption is that the rising and falling limbs of hydrographs are to be modeled separately due to the fact that they translate different physical processes. The rising limb is due mainly to factors external to the watershed, and can be modeled for precipitation. The falling limb is governed by watershed characteristics such as discharge sources and retention capacity. The model assumes the concentual representation of the watershed as two conceptual representation of the watershed as two linear reservoirs. Any sequence of recession dis-charge is then a stochastic output from these two reservoirs. The model was tested for a case study using observed streamflow data from the Powell River. Results are acceptable for all but the autumn data. This suggests that the direct runoff parameters warrant further study. (Titus-FRC) W81-03710

ANALYSIS OF SURPLUS- AND DEFICIT-USING RUNS, Indian Inst. of Tech., New Delhi. Dept. of Civil

Engineering. S. Chander, N. S. Kambo, S. K. Spolia, and A.

Journal of Hydrology, Vol 49, No 1/2, p 193-208, January, 1981. 8 Fig, 12 Ref.

Descriptors: \*Mathematical studies, \*Streamflow forecasting, Flood forecasting, Droughts, Analysis,

Crossing properties of a streamflow sequence are analyzed using a T-function and power transformation for the analysis of run length (number of observations between successive crossings in the opposite direction) and expected run sum (cumula tive value of observations in a run) of a skewed correlated process. Here, the run sum distribution quantifying the extent of shortages or excesses

during the deficit or surplus period has been determined analytically. Annual flow data for the Krishna River, India, from 1901 to 1960 are analyzed as an illustration. Conclusions from the study are: skewness has a marginal effect on expected run lengths of the annual runoff data, skewness increases or decreases the expected surplus or defi-cit run sum of annual flow data, and the probability distribution of the extent of shortages or surpluses in 2 consecutive years can be analytically estimated. (Cassar-FRC) W81-03720

FLOOD PROFILES AND INUNDATED AREAS ALONG THE UPPER COWLITZ RIVER, LEWIS COUNTY, WASHINGTON, Geological Survey, Tacoma, WA. Water Resources Div. M. B. Miles.

Geological Survey Open-File Report 80-225 (WRI), 1980. 18 p, 4 Fig, 3 Tab.

Descriptors: \*Flood profiles, \*Flood plains, \*Flood peak, \*Streamflow, Flood recurrence interval, Flood forecasting, Flood damage, \*Washington, Lewis County, Cowlitz River.

Extensive flooding occurred on a 37.2-mile reach of the Cowlitz River, Lewis County, Wash., on December 2-3, 1977. The flood profile, computed from high-water marks, was 25 feet above that for medium flow near the downstream end of the reach and decreased uniformly to 7 feet above medium flow at the upstream end. Overbank areas inundated averaged about a mile in width throughthe country the reach and caused damage to residential. nundated averaged about a mile in width through-out the reach and caused damage to residential areas of the towns of Packwood and Randle. The peak discharge at the downstream end of the reach, was 89,300 cu ft/s and was the largest that occurred in a 30-year period of record. The peak discharge at the upstream end of the reach was 36,200 cu ft/s and was the second largest that 30,000 cu 11/8 and was the second argest that occurred in a 49-year period of record; the largest peak discharge observed occurred on December 21, 1933, and was 36,600 cu ft/s. The recurrence interval for the December 2-3, 1977 flood, computinterval for the December 2-3, 1977 flood, comput-ed from a frequency analyses of recorded peak discharges, was greater than 100 years at the downstream end of the reach and about 45 years at the upstream end. The 100-year flood at the re-spective reach ends would have a peak discharge of about 82,500 cu ft/s and about 43,000 cu ft/s. (USGS) W81-03731

HURRICANE FREDERIC TIDAL FLOODS OF FORTHMER 12-13, 199, ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUAD-RANGLES, MISSISSIPPI, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03733

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, GRAND BAY QUADRANGLE, ALA-

BAMA, Geological Survey of Alabama, Montgomery. Water Resources Div.

For primary bibliographic entry see Field 7C. W81-03734

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, CHICKASAW QUADRANGLE, ALA-BAMA,

Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03735

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, MOBILE QUADRANGLE, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03736

#### Streamflow and Runoff-Group 2E

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, HOLLINGERS ISLAND-THEODORE QUADRANGLES, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03737

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, CODEN-BELLEFONTAINE QUADRANGLES, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03738

HURRICANE FREDERIC TIDAL FLOODS OF HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, HERON BAY, LITTLE DAUPHIN ISLAND, FORT MORGAN, AND FORT MORGAN NW QUADRANGLES, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03739

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, THE BASIN, BAY MINETTE NORTH, AND CREOLA NE QUADRANGLES, ALA-

AND CREDLA NE QUADRANGLES, ALA-BAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03740

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, HURRICANE QUADRANGLE, ALA-

Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03741

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, BRIDGEHEAD QUADRANGLE, ALA-

Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03742

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, DAPHNE-POINT CLEAR QUADRAN-Geological Survey of Alabama, Montgomery.
Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-03743

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, MAGNOLIA SPRINGS QUADRAN-GLE, ALABAMA,

Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03740

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, BON SECOUR BAY QUADRANGLE, ALABAMA,

ALADAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03745

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF

#### Field 2—WATER CYCLE

#### Group 2E-Streamflow and Runoff

COAST, PINE BEACH, ST. ANDREWS BAY, AND FORT MORGAN QUADRANGLES, ALABAMA,

Geological Survey of Alabama, Montgomery. Water Resources Div.

For primary bibliographic entry see Field 7C. W81-03746

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, GULF SHORES QUADRANGLE, ALA-BAMA.

Geological Survey of Alabama, Montgomery. Water Resources Div.

For primary bibliographic entry see Field 7C. W81-03747

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, ORANGE BEACH QUADRANGLE, AL-

ABAMA,
Geological Survey of Alabama, Montgomery.
Water Resources Div.
For primary bibliographic entry see Field 7C.

W81-03748

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, LILLIAN QUADRANGLE, ALABAMA, Geological Survey of Alabama, Montgomery Water Resources Div. For primary bibliographic entry see Field 7C. W81-03749

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, PERDIDO BAY QUADRANGLE, FLORIDA.

Geological Survey of Alabama, Montgomery. Water Resources Div. For primary bibliographic entry see Field 7C. W81-03750

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, WEST PENSACOLA QUADRANGLE,

FLORIDA, Geological Survey, Tallahassee, FL. Water Resources Div.

For primary bibliographic entry see Field 7C. W81-03751

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, GULF BREEZE-FORT BARRANCAS QUADRANGLES, FLORIDA, Geological Survey, Tallahassee, FL. Water Re-

sources Div. For primary bibliographic entry see Field 7C.

W81-03752

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, ORIOLE BEACH, GARCON POINT, HOLLEY, SOUTH OF HOLLEY, AND NA-VARRE QUADRANGLES, FLORIDA, Geological Survey, Tallahassee, FL. Water Re-

sources Div. For primary bibliographic entry see Field 7C. W81-03753

#### 2F. Groundwater

DIFFERING POSITIONS OF SALINE INTER-FACES IN AQUIFERS AND OBSERVATION BOREHOLES,

Birmingham Univ. (England). Dept. of Civil Engi-K. R. Rushton

Journal of Hydrology, Vol 48, No 1/2, p 185-189, August, 1980. 2 Fig, 3 Ref.

Descriptors: Boundaries, \*Groundwater move-ment, \*Salinity, \*Aquifers, Boreholes, Unconfined

aquifers, Interfaces, \*Saline -freshwater interfaces, Limestone, Hydraulics, Wells, Groundwater, Hydrostatic level.

a recent field investigation observation boreholes were drilled near an abstraction borehole, revealing that the saline interface in the borehole did not coincide with the interface in the aquifer. This preliminary study explains the phenomenon in terms of the laws of hydrostatics. In many aquifers fresh water lies on top of saline water. The interface position within the aquifer depends on the laws of groundwater flow, together with two complex moving boundary conditions. Equations are presented to illustrate the magnitude of the observed effects. Further monitoring of the movement of the saline interface is needed. Two approaches are suggested, using independent piezoneters each with a small open-hole area, and using packers to separate off part of the open hole. (Titus-FRC) did not coincide with the interface in the aquifer. Titus-FRC)

DIFFERING POSITIONS OF SALINE INTER-FACES IN AQUIFERS AND OBSERVATION BOREHOLES - COMMENTS,

F. A. Kohout. Journal of Hydrology, Vol 48, No 1/2, p 191-195, August, 1980. 1 Tab, 12 Ref.

Descriptors: \*Boreholes, \*Saline-freshwater interfaces, \*Groundwater, Chlorine, Salinity, Aquifers, Unconfined aquifers, Interfaces, Limestone, Hydraulics, Wells, \*Coastal aquifers.

Data collected in 1954 from an unconfined, solu-Data collected in 1954 from an unconfined, solu-tion-riddled limestone aquifer in Florida formed the basis for a critique of an analysis of coastal aquifer composition by Rushton. No data was found to support Rushton's proposal of a sharp fluid interface in a coastal aquifer. Dispersion was recommended as a more accurate depiction of the groundwater processes involved. The chlorinity gradients presented as support for the dispersion model were obtained by withdrawing not more than a gallon of water from a small-diameter drop pipe placed in open borcholes. With this process, it is possible to prepare accurate cross-sections of the cone of diffusion and of the pressure-head field cone of diffusion and of the pressure-head field throughout the variable-density environment of an inhomogeneous aquifer. (Titus-FRC) W81-03707

CHEMICAL COMPOSITION OF GROUND-WATERS IN THE VAST KALAHARI FLAT-LAND.

LAND, Weizmann Inst. of Science, Rehovot (Israel). E. Mazor, M. Bielsky, B. T. Verhagen, J. P. F. Sellschop, and L. Hutton. Journal of Hydrology, Vol 48, No 1/2, p 147-165, August, 1980. 8 Fig. 2 Tab, 8 Ref.

Descriptors: \*Groundwater, \*Chemical reactions, \*Chemical analysis, \*Arid lands, Geologic formations, Minerals, Flow, Aquifers, Infiltration, Rainfall, Precipitation, Deserts, Sand, Sodium chloride, Sulfates, Carbonates, \*Kalahari, Africa, Water analysis.

The process of geochemical evolution of ground-water in the Kalahari is investigated. The Kalahari is a case study in which many complicating factors are minimized. Such factors include subsurface lat-eral flow, variable rainfall regimes, high evapora-tion rates, interference by man, and clay and limestone aquifers. The evolution of groundwater occurs rapidly, as evidenced by carbon-14 tracing. In the evolutionary process, it appears that rain water infiltrates the ground directly. Biogenic carbon dioxide is added to the water in the soil, and this water reacts with feldspars, heavy minerals, and basalt to form sodium, calcium, and mag-nesium bicarbonates. At a concentration of 10 meq per liter calcite is precipitated from the bicarbonate and widespread calcrete is formed. Sulfates are introduced by marine winds, as is sodium chloride. (Titus-FRC) W81-03712

AQUIFER RESPONSE TO FORECASTING INPUTS.

Birmingham Univ. (England) Dept. of Civil Enginary bibliographic entry see Field 6A

ANALYSIS OF THE TRANSIENT MOVEMENT OF WATER AND SOLUTES IN STREAM-AQUIFER SYSTEMS,

California Univ., Davis. Dept. of Land, Air and Water Resources. M A Marino

Journal of Hydrology, Vol 49, No 1/2, p 1-17, January, 1981. 10 Fig, 17 Ref.

Descriptors: \*Soil water movement, \*Solute transport, \*Groundwater movement, Path of pollutants, Porous media, Aquifers, Streams, Solutes, Model studies, Mathematical studies.

A Galerkin-type finite-element method is used to A Gateran-type indecelement mention is used to formulate the problem of simulating the transient movement of water in saturated or partially-saturated porous media. This was applied, in particular, to stream-aquifer systems that are hydraulically connected. This study is concerned with the results of changes in stage in a contaminated stream. The cross sectional representation of the flow system is divided into linear triangular elements. Parameters considered are advection, dispersion, sorption, a first-order reaction, and a source or sink for the solute. A hypothetical case was tested and results found reasonable, although no means for testing absolute accuracy was possible. The method should be applicable to 2-dimensional water and solute migration problems. (Cassar-FRC) W81-03717

ESTIMATION OF THE TRANSMISSIVITY OF THIN LEAKY-CONFINED AQUIFERS FROM SINGLE-WELL PUMPING TESTS,

British Petroleum Co. Ltd., London (England). F. Worthington

Journal of Hydrology, Vol 49, No 1/2, p 19-30, January, 1981. 5 Fig, 2 Tab, 13 Ref.

Descriptors: \*Pumping, \*Test wells, \*Transmissi-vity, Aquifer characteristics, Wells, Drawdown, Water yield, Hydrogeology, Groundwater movement, Aquifer testing

Aquifer transmissivity was estimated from time-variant and quasi-equilibrium drawdown data variant and quast-equinorm drawtown day measured in a single pumped well. This method, applicable to thin leaky-confined aquifers, is a useful reconnaissance tool when observation wells are unavailable for financial or other reasons. Data are unavailable for financial or other reasons. Data from the quasi-equilibrium phases of a step draw-down test are used to evaluate the coefficient of non-linear head losses subject to the assumption of a constant effective well radius. A pseudo-transmissivity curve passes through a minimum when there is a least manifestation of casing-storage and leakage effects. This minimum value, after adjustment for partial penetration effects, is the best possible estimate of aquifer transmissivity. The procedure is applied to a trial borehole in the Miocene calcasar-FRC) Africa. (Cassar-FRC)

GROUND-WATER DATA FOR THE RILEY AND ANDREWS RESOURCE AREAS, SOUTH-EASTERN OREGON, Geological Survey, Portland, OR. Water Re-

P. J. Townley, C. M. Soja, and W. C. Sidle Geological Survey Open-File Report 80-419, 1980. 32 p, 3 Fig, 1 Plate, 6 Tab, 17 Ref.

Descriptors: \*Water quality, \*Wells, \*Water levels, \*Well data, Oregon, Observation wells, Drillers logs, Hot springs, Water use, Chemical analysis, Hydrographs, Maps, Riley resource area, Andrews resource area, \*Harney County, Southers Oregon, Creen Creen, \*Creen, \*Cre

Appraisals of the resources of selected manage ment areas in eastern Oregon are being made by the U.S. Bureau of Land Mangement. To provide needed hydrologic information, the Bureau of

eastern Oregon.

#### Water In Soils-Group 2G

Land Management requested the U.S. Geological Survey to inventory ground-water data for the Riley and Andrews Resource Areas. The inventory included field location of selected wells and springs; measurement of ground-water levels, temperatures, specific conductance, and pH; and the collection of ground-water samples from selected conection of ground-water samples from selected sources to determine dissolved chemical constituents. Included in this report are well data, drillers' lithologic logs, hydrographs of observation wells, a summary of observation-well data, and chemical analyses of ground water. (USGS) W81-03732

GROUNDWATER-IN THE EIGHTIES, National Water Well Association, Worthington, OH

J. H. Lehr. Water/Engineering and Management, Vol 128, No 3, p 30-33, March, 1981. 1 Fig, 2 Tab.

Descriptors: \*Groundwater potential, \*Groundwater mining, "Groundwater pollution, Water resources management, Groundwater movement, Groundwater availability, Water supply development, Geothermal resources.

Although in almost every part of the United States there is 20 to 30 times more fresh water under ground than exists in all surface streams, surface water use in the country is more than three times that of groundwater. This is true in spite of the fact that it costs 5 times as much worldwide to control one cubic kilometer of water with a dam than to control the same volume with a well field. In the United States, it costs 10 times as much to use a dam. Only five states use more groundwater than surface water. Advantages of groundwater devel-opment include lower cost, avoidance of water loss to evaporation, preservation of the surface land, elimination of the intense effects of flood-drought cycles, avoidance of the loss of storage volume due to siltation, and minimization of the potential for pollution. The preference for surface water use is a product of the visibility of dams and the invisibility product of the visibility of dams and the invisibility of groundwater, Federal programs geared to development of surface water resources, a preference by engineers to build dams, the effect of dams on land prices, and the desire by politicians to acquire status from dam construction. Increasing use of groundwater can be expected in the future. Regulations will be needed to control use of the resource and to prevent pollution. Groundwater also offers an alternative angregueoure. This source. source and to prevent pollution. Groundwater also offers an alternative energy source. This source of geothermal energy can be tapped using a groundwater property of the pump to utilize the groundwater for heating in the winter and for cooling in the summer. (Carroll-FRC) W31-03791

CHEMICAL REACTIONS OF SEAWATER WITH ROCKS AND FRESHWATER: EXPERIMENTAL AND FIELD OBSERVATIONS ON BRACKISH WATERS IN ISRAEL,

Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water. For primary bibliographic entry see Field 2K. W81-03862

GROUND-WATER AVAILABILITY, HOCKES-SIN, DELAWARE.

Camp Dresser and McKee, Inc., Boston, MA. P. M. Williams.

Ground Water, Vol 19, No 1, p 58-66, January-February, 1981. 9 Fig, 1 Tab, 16 Ref.

Descriptors: \*Groundwater availability. storage, \*Aquifer characteristics, Hydrologic budget, Watershed management, Groundwater re-charge, Pumping, Water supply, Water table, \*Hockessin, Delaware, Recharge, Drawdown, Natural recharge, Water wells, Runoff, Stream-\*Aquifer characteristics, Hydrologic flow, Surface-groundwater relationships, Geohydrologic units.

The groundwater availability in a small multia-quifer 3.8 sq mile basin at Hockessin, Delaware, was studied for 4 years, 1974-78. This water has been pumped at a rate approaching the long-term recharge rate. The area consists of saprolite over-

lying Cockeysville marble, favorable for water production, and Wissahickon schist, relatively poor for water production. The marble comprises poor for water production. In marrie comprises the manageable storage area, about 1/3 of the basin, and the schist serves as a recharge area. The water company maintained its desired high pumping rates throughout a 21 month period of half ing rates throughout a 21 month period of half normal groundwater recharge. During this time storage reduction was estimated at 950 million gallons, and streamflow reduction was evident. Total pumpage and stream base flow were twice that expected under normal groundwater runoff conditions in a dry year. It appears that the Hockessin basin water development has reached the limit of the long term average, techarge, rate. the limit of the long term average recharge rate. The storage capacity should remain sufficient to withstand 1 or 2 years of drought. (Cassar-FRC)

HORIZONTAL ANISOTROPY DETERMINED BY PUMPING IN TWO POWDER RIVER BASIN COAL AQUIFERS, MONTANA,

Geological Survey, Pittsburgh, PA. J. D. Stoner.

Ground Water, Vol 19, No 1, p 34-40, January-February, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: \*Anisotropy, \*Coal, \*Aquifer testing, Hydraulic conductivity, Test wells, Wells, Drawdown, \*Groundwater movement, Geologic formations, Hydrogeology, \*Powder River Basin, Montana, Pumping, Permeability, Conductivity.

Anisotropic behavior was observed in two coal aquifers in southeast Montana using 5-well and 4well aquifer tests for the Sawyer-A and Anderson well aquifer tests for the Sawyer-A and Anderson beds, respectively. Average maximum hydraulic conductivity for the Sawyer-A aquifer was 0.65 meters per day at a bearing of N.85 degrees E. The average minimum hydraulic conductivity, perpendicular to the maximum, was 0.26 meters per day. This heterogeneous formation contained a lignite coal with poorly developed cleat, the probable cause of the wide range of principal axis orientations. The maximum hydraulic conductivity of the tions. The maximum hydraulic conductivity of the Anderson formation, containing subbituminous-C coal, was 0.20 meters per day bearing N.32 degrees W. The minimum hydraulic conductivity was 0.07 meters per day. Cleat spacing (less than 7 cm) was similar to or slightly less than that of the Sawyer-A country of the complex country of the site. These complex aquifers are best examined with a 5-well test. Data from single wells gave with a 3-well test. Data from single Wells gave hydraulic conductivities lower than the actual average values. Well storage and aquifer dewater-ing slightly affected drawdowns of the pumped well during both tests. (Cassar-FRC) W81-03894

#### 2G. Water In Soils

FIELD MEASUREMENT OF SEEPAGE AND EVAPOTRANSPIRATION RATE FOR A SOIL UNDER PLANT COVER: A COMPARISON OF SOIL WATER BALANCE AND TRITIUM LA-BELING PROCEDURE,

Forstliche Forschungsanstalt, Munich (Germany, F.R.). Inst. fuer Bodenkunde.

For primary bibliographic entry see Field 2D. W81-03711

MOVEMENT OF WATER AND NITRATE IN THE UNSATURATED ZONE OF UPPER CHALK NEAR WINCHESTER, HANTS., ENG-

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5B. W81-03715

EXPERIMENTAL EVALUATION OF TWO IN-FILTRATION MODELS, Minnesota Univ., St. Paul. Dept. of Agricultural

Engineering F. I. Idike, C. L. Larson, D. C. Slack, and R. A. Young.

Transactions of the ASAE, Vol 23, No 6, p 1428-1433, November/December, 1980. 6 Fig, 3 Tab, 28

Descriptors: \*Infiltration, \*Ponding, \*Model studies, Hydrology, \*Soil water movement, Holtan model. Green-Ampt model. Mathematical studies.

The Holtan model and the Green-Ampt model as modified by Mein and Larson (GAML) were used mounted by Ment and Larson (GAML) were used to calculate infiltration from constant application rates. These values were compared with experimental data from five field tests on a single soil type to compare the methods. The Holtan model, whose parameters were evaluated by fitting, predicted infiltration during the middle and latter portions of the experimental runs, but failed to predict delayed surface ponding in most cases. The GAML method, using the Campbell method to predict unsaturated conductivities to evaluate the parameter, average capillary suction at the wetting front, predicted infiltration rates after ponding well in most cases. It predicted delayed ponding very well in four cases and acceptably in the fifth case. (Cassar-FRC) W81-03767

THE INFLUENCE OF SOIL MOISTURE ON UREA HYDROLYSIS AND MICROBIAL RES-PIRATION IN JACK PINE HUMUS.

PIRATION IN JACK PINE HUMUS, Great Lakes Forest Research Centre, Sault Ste. Marie (Ontario). Environment Dept. N. W. Foster, E. G. Beauchamp, and C. T. Corke. Canadian Journal of Soil Science, Vol 60, No 4, p 675-684, November, 1980. 6 Fig, 1 Tab, 29 Ref.

Descriptors: \*Soil moisture retention, \*Ureas, Hydrolysis, Forest hydrology, Hydrology, Forest soil, Soil types, Forest, Decomposing organic matter, Microbial degradation, \*Ontario, Cha-

A study was made to determine how large changes in soil moisture influence urease activity and mi-crobial respiration in jack pine L and F horizon materials. Samples were taken near Chapleau, Onmaterials. Samples were taken near Chapleau, Ontario. The soil at the sampling site was gravel underlying 30-60 cm of silty loam-loamy sand and had an Eluviated Dystric Brunisol profile. Low soil moisture appeared to be a key factor in uptake of urea nitrogen in fertilized pine soils because, under forest conditions, a thin pine humus layer was very susceptible to drying. When urea was applied to the dry humus, its hydrolysis was drastically retarded. A considerable retardation in urea hydrolysis also occurred when moist, urea-treated humus was allowed to dry in the lab. Initial microhial respiration rates in response to urea increased bial respiration rates in response to urea increased with an increase in soil moisture from 20 to 300%. Drying of initially moist soil significantly reduced microbial respiration in fertilized soil by an average of 25% that observed in a constantly moist soil. (Baker-FRC) W81-03836

SOIL MOISTURE VARIATIONS UNDER RURAL SURFACE COVERS AT ELLERSLIE, ALBERTA, Illinois State Water Survey, Urbana

S. J. Cohen.

Canadian Journal of Soil Science, Vol 60, No 4, p 613-623, November, 1980. 2 Fig, 6 Tab, 13 Ref.

Descriptors: \*Soil moisture retention, \*Rural areas, \*Land use, Hydrology, Soil types, Land manage-ment, Forest hydrology, Forest, Weather, \*Alberta. Ellerslie

The effects of rural land uses were studied as they relate to surface characteristics, soil moisture and soil water use. Certain generalizations were tested soil water use. Certain generalizations were tested under direct observation on several rural surfaces. Significant differences in soil moisture had developed, in spite of the fact that the test plots examined were small in size. These differences imply that the plots did not have the same depletion rates under the particular set of weather conditions prevailing during some previous time period. The under the particular set of weather continuous pic-vailing during some previous time period. The high density of tree plots was considered a likely factor in observed production of much lower soil moisture values for these plots than for open plots because of higher interception losses. When active, barley consumed the most soil water, but recharge was sufficient outside its growing period. It ap-pears that canopy structure and growth character-

#### Field 2-WATER CYCLE

#### Group 2G-Water In Soils

istics have significant influences on soil moisture values and can overshadow the influence of weather on various occasions. (Baker-FRC) W81-03837

GRAPHICAL PREDICTION OF POROSITY AND WATER RETENTION IN SAND-SOIL MIXTURES FOR DRAINED TURF SITES, Illinois Univ. at Urbana-Champaign. Dept. of Hor-

ticulture

Canadian Journal of Soil Science, Vol 60, No 1, p 787-791, November, 1980. 3 Fig. 8 Ref.

Descriptors: \*Model studies, \*Porosity, \*Soil mois-ture retention, Soil porosity, Interstitial water, Soil physical properties, Graphical methods, Math-ematical studies, Soil types, Sand.

A simple, easily drafted graphical form of a model developed by Spomer is described for the practical prediction of sand-soil mixture properties from knowledge of the components' inherent porosities and their bulk volume proportions in the mixture. This model can be applied to cases where the sand particles are several degrees of magnitude larger than the soil particles. The model also assumes that the majority of the pores characteristic of the soil remain saturated and those of the sand unsaturated remain saturated and those of the sand unsaturated under the capillary influence of the shallow drainage system 20-40 cm beneath its surface. It is suggested that the model would be useful as an applied tool, assisting in the determination of the correct sand-soil mixtures for use in shallow-drained turf sites. (Baker-FRC)

#### 2H. Lakes

LOST CREEK LAKE TURBIDITY STUDY

Army Engineer District, Portland, OR. For primary bibliographic entry see Field 5G. W81-03649

SYNOPSIS OF WES EWOOS INVESTIGA-TIONS TO IMPROVE WATER QUALITY BY GAS TRANSFER TECHNIQUES BOTH IN THE RESERVOIR AND IN THE RELEASE,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 5G.

ON RESERVOIR RELIABILITY, Natal Univ., Durban (South Africa). Dept. of Civil Engineering. G. S. Pegram.

Journal of Hydrology, Vol 47, No 3/4, p 269-296, July, 1980. 10 Tab, 3 Fig, 12 Ref.

Descriptors: \*Reservoirs, \*Reservoir capacity, \*Mathematical equations, Simulation analysis, Probabilistic process, Storage capacity, Water storage, Mathematical analysis, Mathematical studies, Finite difference methods, Correlation analysis,

Finite-difference equations, integral equations and simulation are employed to ascertain mean first passage times of a non-seasonal reservoir fed by various input distributions. These include the normal, lognormal and discrete inputs, both inde-pendent and serially correlated. Included are de-scriptions of each method and some watchpoints. For example, care must be given to interpreting the results of simulations because of the large sam-pling variation of the mean time of first return to emptiness. Also, numerical solution of the integral equation for storage distribution is more difficult to set up but more efficient than the difference equa-tion method, because error bounds on the computations can be more readily found. The results of tations can be more reason yould. The testins of this process are accurate to within three significant figures or better; it was found that for large capacity, skewness, correlation and mean net input, great difficulty was experienced in obtaining accurate results. However, the results could serve as useful checks for various methods of determining reservoir reliability. Results on discrete reservoirs yield good approximations to the continuous state-space reservoir, and have potential application in the design of reservoir supply systems. (Titus-FRC) W81-03708

UNCERTAINTIES IN ESTIMATING THE WATER BALANCE OF LAKES, Geological Survey, Lakewood, CO. T. C. Winter.

T. C. Winter. Water Resources Bulletin, Vol 17, No 1, p 82-115, February, 1981. 10 Fig, 9 Tab, 163 Ref.

Descriptors: \*Lakes, \*Hydrologic budget, \*Evaporation, Precipitation, Runoff, Errors, Reservoirs, Reviews, Stream flow, Flow, Volume, Lake mor-Groundwater movement, Seepage, phometry, Groundy Rainfall, Bathymetry.

Many errors are possible in calculating the water balance of lakes. Sampling and analysis techniques may be in question. The physics of evaporation, groundwater flow near the lake, and seepage through lake beds are often ignored because they are not easily determined. A literature review analyzed papers on error analysis in hydrology. Pre cipitation measurements have a wide range of error—up to 75% in gage placement alone for individual storms, 60% in averaging point precipitation data. These errors decrease with larger numbers of measuring instruments and longer periods of time. Measurements in mountainous areas proof time. Measurements in mountainous areas pro-duce larger errors than in flat terrain. The energy budget method most accurately calculates evapo-ration, with an error of 10-15%. Many types of evaporation pans are used, with varying results. If pans are not placed very near the lake, great error can result. Under ideal conditions stream discharge measurements can be accurate to 5% if recording instruments provide a continuous measure of the water stage. However, errors related to temporal distribution of stream discharge can be as high as 100%. No estimates of errors in overland runoff have been made. Calculations of groundwater movement can produce errors as high as 100% Meters for lake seepage are not always reliable. Determination of lake volume depends on bathymetric maps prepared from soundings. Large lakes and soft-bottomed lakes are hardest to measure accurately. Comparison of several lake water balances in which the residual consists solely of errors in measurement shows that such a residual (groundwater) can differ from an independent estimate of groundwater by more than 100%. (Cassar-FRC) W81-03782

SEASONAL VARIATION OF POTENTIAL NUTRIENT LIMIATION TO CHLOROPHYLL PRODUCTION IN SOUTHERN LAKE HURON, Michigan Univ., Ann Arbor. Great Lakes Research Div.

C.K. Lin, and C. L. Schelske. Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 1, p 1-9, January, 1981. 3 Fig, 4 Tab, 19 Ref.

Descriptors: \*Eutrophication, \*Lake Huron, \*Nutrients, Chlorophyll, Laboratory studies, Phyto-plankton, Productivity, Phosphorus compounds, Silica, Nitrogen compounds, Chelation, Vitamins, Trace metals, Seasonal, Ethylenediaminetetraacetic acid.

The effect of potential nutrient limitation to chlorphyll production in the surface waters of southern Lake Huron was studied in water-phytoplankton samples collected monthly from April to December 1975. The samples were treated as follows: complete treatment (all nutrients--P, N, Si, EDTA, vitamins, and trace metals), complete treatment with deletions, complete treatment with phosphorus concentrations ranging from 1 to 20 micrograms per liter P, and lake water with single grains per liter P, and make water with single nutrients. Phosphorus was the most influential factor in phytoplankton growth. Enrichment with nutrients and the highest P level, 20 micrograms per liter P, produced 5 times the response of nutri-ent mixtures with no P. Minimum levels of P producing significant chlorophyll were 1-3 micrograms P per liter. The secondary limiting nutrients (EDTA, FeEDTA, and vitamins) were necessary to produce heavy crops in summer and fall. Little effect on growth resulted from individual additions of EDTA, N, and Si, or deletion of N from the complete treatment. There was a slight deficiency of Si in July, September, and Cotober, and no apparent deficiency of trace metals at any time. When trace metals were deleted, chlorophyll production frequently increased; however, deletion of both trace metals and EDTA had the opposite effect. (Cassar-FRC) W81-03840

CHEMICAL SPECIES OF COPPER IN THE RIVER SHUKUNOHE AND OHNUMA WATERS IN JAPAN, THE LAKE Hokkaido Univ., Sapporo (Japan). Dept. of Chem-

istry. K. Matsunaga, M. Negishi, S. Fukase, and K.

Geochimica et Cosmochimica Acta, Vol 44, No 10, p 1615-1619, 1980. 2 Fig, 4 Tab, 29 Ref.

Descriptors: \*Copper, \*Natural waters, \*Chemical composition, Water analysis, Shukunohe River, Lake Ohnuma, \*Japan, Lakes, Rivers, Heavy metals, Chemical analysis.

Samples of water from both the Shukunohe River and Lake Ohnuma in Japan were treated by solvent extraction and passed through an anion exchange resin and subsequently measured by atomic absorption spectroscopy to determine the concentrations of both reactive copper and copper associated with organic materials. The findings changed slightly from month to month, but for all the samples the ratio of the amount of organic copper to that of total copper in the lake was about 50%. The ratios in the river water were the same as in to that of total copper in the lake was about 30%. The ratios in the river water were the same as in the lake water. Thermodynamic calculations were made, using fulvic acid. These calculations suggest that the fulvic acid-copper complex accounted for about 10-60% of the total copper. The measurements and the separation of the copper species were carried out after adjusting the pH of the sample solution to 4 because bicarbanate ion save sample solution to 4, because bicarbonate ion gave slight positive interference. The ratios of the com-plexes to total copper obtained on the basis of thermodynamic calculation are in good agreement with the experimental results in the water. (Baker-FRC) W81-03854

HYDROCARBONS AND FATTY ACIDS IN TWO CORES OF LAKE HURON SEDIMENTS, Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. A. Meyers, R. A. Bourbonniere, and N.

Takeuchi. Geochimica et Cosmochimica Acta, Vol 44, No 8, p 1215-1221, 1980. 3 Fig, 38 Ref.

Descriptors: Chemical composition, \*Sediments, \*Hydrocarbons, \*Fatty acids, \*Lake Huron, Aliphatic hydrocarbons, Great Lakes.

Two locations in southeastern Lake Huron were used to secure samples of sediments for analysis for hydrocarbons and fatty acid content. One core showed a relatively high level of organic carbon, which is a reflection of the fine grain size of this sediment. This core demonstrated a lack of major change over depth in organic carbon concentra-tion, combined with a slight but regular decrease in water content due to compaction. This was therefore a non-stratified sediment having no discontinuities. In contrast, the other core samples exhibited marked changes with depth. Concentrations of both organic carbon and water were highest at the surface and lowest at a depth of 3-5 cm in the sediment. This depth corresponds to a coarse-grained sandy layer. Surface concentrations of total aliphatic hydrocarbons were similar at these two locations. A general decrease in aliphatic hydrocarbons was noted in one core, while a drastic decrease was noted from the surface level to a decrease was noted from the surface level to an extension of total fatty acids in one core dropped from 138 microg/g dry sediment at the surface of the 40 microg/g at 20 cm depth. At the surface of the

#### Erosion and Sedimentation—Group 2J

other core fatty acids totaled 132 microg/g, dropping to 8 microg/g in the sandy layer at 3-5 cm depths. The younger core (450 yr) had higher concentrations of hydrocarbons, and most of them were allochthonous. The older core (11,000-12,000 yr) reflected a smaller input of terrigenous material to Lake Huron at that time. (Baker-FRC) W81-03856

POLLUTION RECORDS FROM SEDIMENTS OF THREE LAKES IN NEW YORK STATE, New York State Dept. of Health, Albany. Div. of Labs, and Research.

M. Wahlen, and R. C. Thompson. Geochimica et Cosmochimica Acta, Vol 44, No 2, p 333-339, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: \*Lakes, \*Sediments, \*Trace elements, Cores, Erosion, Heavy metals, Copper, Zinc, Lead, Aluminum, Potassium, Radioactive isotopes, Titanium, Rubidium, Zirconium, Lake Champlain, Lake Canadarago, Sylvan Lake, \*New York,

Sediment samples were taken by gravity coring from Lake Canadarago, Lake Champlain and Sylvan Lake in New York State. Radiometrical dating was performed. The sedimentation rates were determined to be 0.52, 0.14, and 0.11 g/ square centimeter/year, respectively. Variations of calected alemental shared one was a shared or several shared one was the sedimental shared on t square centimeter/year, respectively. Variations of selected elemental abundances were analyzed as functions of depth for the two lakes with lower sedimentation. Aluminum, potassium, titanium, rubidium, and zirconium were correlated among themselves but reflected different variations in the input of terrigenous erosion material to the lakes. Copper, zinc, and lead concentrations correlated among themselves, showing similar depth dependences with increasing concentrations toward the top, which can be attributed to anthropogenic polition. Residence times of 0.15 year for lead and 0.4 year for copper indicate fast removal of these parties for the putter column. Besidence times of metals from the water column. Residence times of 1.0 year for zinc and 2.0 years for copper suggest that these metals are dominated by the water residence time. (Baker-FRC) W81-03860

A CRITICAL COMPARISON OF THE MEASURED SOLUBILITIES OF FERROUS SULPHIDE IN NATURAL WATERS,

Freshwater Biological Association, Ambleside, For primary bibliographic entry see Field 2K. W81-03861

VORTEX MODES IN SOUTHERN LAKE MICHIGAN, National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

RESEARCH LAB.
J. H. Saylor, J. C. K. Huang, and R. O. Reid.
Journal of Physical Oceanography, Vol 10, No 11,
p 1814-1823, November, 1980. 11 Fig, 1 Tab, 16
Ref.

Descriptors: \*Oscillatory waves, \*Wave propaga-tion, Current meters, Lakes, Water temperature, Water currents, \*Lake Michigan, Vortices.

The low-frequency oscillatory wave phenomena observed in Southern Lake Michigan are reported, and the mechanisms producing the resultant current pattern are explained. An array of AMF vector-averaging current meters was used to measure current velocities and water temperatures during late spring, summer, and fall of 1976. Persistent oscillations of nearly four days in a period were at least as energetic as inertial oscillaperiod were at least as energenc as inergial oscinia-tions in the kinetic energy spectra and current hodographs. These four day oscillations were pres-ent at all stations, including those located at the center of the lake basin. This lake-wide oscillation was present during all seasons; current vectors rotated cyclonically near the center of the lake and anticyclonically elsewhere. Rotational oscillations closely fit the characteristics of barotropic secondcloses motions of a basin with variable depth (Lamb 1932). Lake shape and bathymetry govern the kinematic properties and natural period of topo-

graphic votex modes. The gravest mode was unique among waves in having nonzero velocity at the lake center, and evidence indicated that this mode was present in southern Lake Michigan. (Small-FRC) W81-03867

AIRBORNE MEASUREMENTS OF WAVE GROWTH FOR STABLE AND UNSTABLE ATMOSPHERES IN LAKE MICHIGAN, National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.

P. C. Liu, and D. B. Ross. Journal of Physical Oceanography, Vol 10, No 11, p 1842-1853, November, 1980. 15 Fig, 1 Tab, 17 Ref.

Descriptors: \*Wind waves, \*Wave height, \*Mete-orological data collection, Waves, Lakes, Wind velocity, Wave propagation, Atmosphere, \*Lake

Synoptic wave conditions were measured during an autumn storm on Lake Michigan, and the data were used to develop synoptic wave height maps. Also, fetch-limited spatial growth of spectral wave components and their correlations with the parametrized dynamic growth processes were exam-ined. Airborne laser profilometers and Waverider buoys were used to measure wave conditions during the passage of an intense cold front in 1977. Measurements made before and after the passing of the front demonstrated the distinctive role of stability in the wave growth process. The wind speed and fetch distance required to generate the same wave conditions were less for an unstable atmosphere than for a stable atmosphere. Thus, higher waves usually accompany an unstable atmosphere for the same 10 mile winds. Fetch-limited wave provided from the same to mile winds. Fetch-limited wave growth followed stable or unstable quasi-equilibrium relations between corresponding wave-energy and peak energy frequency parameters. (Small-FRC) W81-03868

ATTEMPT TO APPLY A MODEL FOR STUDY-ING FISHERIES IN INTERTROPICAL FLOOD PLAINS AT LAKE ALAOTRA (MADAGAS-CAR), (ESSAI D'APPLICATION AU LAC ALAOTRA (MADAGASCAR) D'UN MODELE PORTITIES DES REGUEDIES POUR ES D'ETUDE PLAINES DES PECHERIES POUR LES D'INONDATION INTERTROPI-

Ecole National Superieure Agronomique de Tou-louse (France). Lab. de Ichtyologie Appliquee. For primary bibliographic entry see Field 81.

#### 2I. Water In Plants

A PREDICTIVE MODEL OF WATER STRESS IN CORN AND SOYBEANS, Washington State Univ., Pullman. Dept. of Agri-

cultural Engineering.
R. A. Sudar, K. E. Saxton, and R. G. Spomer.
Transactions of the ASAE, Vol 24, No 1, p 97-102,
January-February, 1981. 8 Fig. 2 Tab, 22 Ref.

Descriptors: \*Model studies, \*Water stress, Stress, Water supply, \*Corn, \*Soybeans, Crop yield, Crop production, Prediction. Forecasting, \*Soil-water-plant relationships.

The Soil-Plant-Air-Water (SPAW) model was expanded to meet the growing need to accurately forecast crop water stress and its effect on crop growth and yields. Revisions involved the devel-opment of feedback loops between crop transpira-tion deficits and canopy development and the phenologic state. A crop yield water stress index was developed based on the ratio of actual to potential transpiration and variable yield suscepti-bility relationships during the growing season. At the end of the growing season the accumulated index was correlated with crop yield. Yield reducindex was contented with crop yield. The clause tion caused by soil moisture stress was then calcu-lated. Corn and soybean growth was studied using this method. The calibrated model was applied to data from Grundy County, Missouri, for model verification. The expanded SPAW model could be used to compute soil moisture and water stress indices that correlate well with crop yields. These predictions are based on the daily integrated effects of climate, crop, and soil characteristics. The method will be useful for predicting regional crop water stress and crop yield. (Baker-FRC) W81-03761

#### 2J. Erosion and Sedimentation

LABORATORY STUDY OF AGGRADATION IN ALLUVIAL CHANNELS, Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering.

Journal of Hydrology, Vol 49, No 1/2, p 87-106, January, 1981. 12 Fig, 3 Tab, 16 Ref.

Descriptors: \*Aggradation, \*Erosion, \*Sediment transport, Deposition(Sediments), Bed load, Rivers, Stream erosion, Streambeds, \*Alluvial channels, Channels, Mathematical studies, Labora-

Aggradation in alluvial channels has been studied analytically, and little but idealized experimental work has been done. This paper reports laboratory work has been done. This paper reports laboratory experiments on aggradation caused by the addition of excess sediment load. A similarity curve method for predicting aggradation under these circumstances is presented. This can yield quick estimates of the aggradation extent and magnitude, knowing measurable parameters such as mean velocity of flow, depth of flow, and equilibrium transport rate. The curves for river bed elevation obtained compared well with data from work by Cunge and Perdreau (1973). (Cassar-FRC)

AN ERROR FUNCTION SOLUTION OF SEDI-MENT TRANSPORT IN AGGRADING CHAN-

NELS, Puniab Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering. J. P. Soni.

Journal of Hydrology, Vol 49, No 1/2, p 107-119, January, 1981. 8 Fig, 1 Tab, 13 Ref.

Descriptors: \*Aggradation, \*Erosion, \*Sediment transport, Deposition(Sediments), Bed load, Rivers, Stream erosion, Streambeds, \*Alluvial channels, Channels, Mathematical studies.

An equation has been developed to represent the unsteady sediment transport law on the aggraded reach of an alluvial channel when the excess sediment supply is taking place at a constant and continuous rate. Tested against laboratory data, it showed very good agreement. The uniform sediment transport law, dependent upon the height of sand waves and average bed wave velocity, cannot be directly applied to the unsteady/nonuniform flow conditions present during aggradation. The unsteady transport law obtained in the presence of ausport law obtained in the presence of aggradation is dependent upon a single parameter. The theoretical length of aggradation may be calculated. (Cassar-FRC) w81-03722

SEDIMENT AND CHEMICAL CONTENT OF AGRICULTURAL DRAINAGE WATER, Ohio Agricultural Research and Development Center, Columbus. Dept. of Agricultural Engineer-

G. O. Schwab, N. R. Fausey, and D. E. Kopcak. Transactions of the ASAE, Vol 23, No 6, p 1446-1449, November/December, 1980. 2 Fig. 5 Tab, 11

Descriptors: \*Sediment transport, \*Runoff, \*Rain water, Nitrates, Surface drainage, Drainage, Excess water(Soils), Agriculture, Soil chemical properties, Pipes, Crops, Water pollution control, \*Agricultural runoff, \*Chemical degradation.

Sediment and chemical losses from pipe and surface drainage systems in Ohio were studied for a

#### Field 2—WATER CYCLE

#### Group 2J-Erosion and Sedimentation

10-year period. Sediment losses, varying with crop and cultivation practices, averaged 2548 kg per ha (range, 221-9054) for surface drains, 1529 kg per ha (range, 825-905) in deep pipes, and 218 kg per ha (range, 141-423) in shallow pipes. No-tillage treatment greatly reduced sediment losses. Dormant season sediment losses were 26-40% of annual losses. Annual average chemical losses were as follows (surface drains and shallows). follows (surface drains, deep pipe drains, and shallow pipe drains, respectively, in kg per ha): nitrate-N, 12.1, 18.7, and 11.2, P. 2.2, 12, and 0.8; K, 31.6, 22.5, and 8.7. Dormant chemical losses were 29-57% of annual losses. Drainage water from the site contained less nitrate-N and P, and pH was closer to neutral when compared with rainwater. (Cassar-FRC) W81-03773

#### 2K. Chemical Processes

CHEMICAL COMPOSITION OF GROUND-WATERS IN THE VAST KALAHARI FLAT-

Weizmann Inst. of Science, Rehovot (Israel). For primary bibliographic entry see Field 2F. W81-03712

SEDIMENT AND CHEMICAL CONTENT OF AGRICULTURAL DPAINAGE WATER,

Ohio Agricultural Research and Development Center, Columbus. Dept. of Agricultural Engineer-

ing. For primary bibliographic entry see Field 2J. W81-03773

CARBONATE SATURATION AND THE EFFECT OF PRESSURE ON THE ALKALIN-ITY OF INTERSTITIAL WATERS FROM THE GUATEMALA BASIN.

Washington Univ., Seattle. Dept. of Oceanog-

raphy.
J. W. Murray, S. Emerson, and R. Jahnke.
Geochimica et Cosmochimica Acta, Vol 44, No 7,
p 963-972, 1980. 4 Fig. 5 Tab, 29 Ref.

Descriptors: \*Calcium carbonate, \*Alkalinity, \*Interstitial water, \*Sediment-water interfaces, Sampling, Organic matter, Manganese, Chemical reactions, Carbonates, Chemical precipitation, \*Guate-mala Basin, \*Sediments.

Interstitial water samples from the sediments of Interstitual water samples from the secuments of Guatemala Basin were collected using two methods: an in situ sampler and centrifugation of box core sediment samples. Although results from the two methods agreed well for Mn, Si and phostwo methods agreed well for Mn, Si and phosphate, alkalinity in box core samples was less than in situ samples. This was caused by CaCO3 precipitating with the decrease in pressure as the sample was brought to the sea surface. The changes in alkalinity calculated from basic equations of the carbonate system agreed well with observed values. A sharp decrease in pH observed just below the sediment/water interface was attributed to vidiation of creating matter by oxygen in uted to oxidation of organic matter by oxygen in the absence of CaCO3. Alkalinity increased during the reduction of MnO2 and release of Mn(2+) to the interstitial water. Interstitial waters became undersaturated with CaCO3 immediately below the sediment/water interface and returned to saturation deeper in the sediment. (Cassar-FRC) W81-03853

SULFUR ISOTOPE SYSTEMATICS IN ICE-LANDIC GEOTHERMAL SYSTEMS AND IN-FLUENCE OF SEAWATER CIRCULATION AT

Okayama Univ. (Japan). Inst. for Thermal Spring

H. Sakai, E. Gunnlaugsson, J. Tomasson, and J. E. Geochimica et Cosmochimica Acta, Vol 44, No 8, p 1223-1231, 1980. 4 Fig, 3 Tab, 29 Ref.

Descriptors: \*Sulfur, \*Geothermal studies, Basalts, Crystalline rocks, Geophysics, Water temperature, Iceland, Sulfate, Sulfides, Thermal springs,

The sulfur isotope ratios of pyrites in altered basalts from two types of Icelandic geothermal fields were evaluated. In both cases samples were oxidized to sulfate by hot aqua regia and sulfate was precipitated as barium sulfate. The sulfur content of these basalts was much lower than the 800 ppm estimated for undifferentiated, undegassed oceanfloor basalts. The ones analyzed here must have lost most of their sulfur before solidification. In meteoric seawater the source of the sulfur was suggested as basalt. In mixed meteoric seawater the sulfide sulfur was enriched in S-34 up to 8% compared to basaltic values, which indicated a mixture pared to basaltic values, which indicated a mixture of seawater sulfur and basaltic sulfur. Disequilibrium between sulfate and sulfide is also demonstrated in Icelandic geothermal systems. (Baker-FRC) W81-03857.

A CRITICAL COMPARISON OF THE MEAS-URED SOLUBILITIES OF FERROUS SUL-PHIDE IN NATURAL WATERS,

Biological Association, Ambleside, W. Davison.

Geochimica et Cosmochimica Acta, Vol 44, No 6, p 803-808, 1980. 1 Fig, 2 Tab, 48 Ref.

Descriptors: \*Sulfides, \*Iron compounds, \*Solubil-ity, \*Natural waters, Anaerobic conditions, Chemi-cal properties, Chemical precipitation, Lakes, Black Sea.

Activity coefficients and calculation procedures for obtaining the solubility of ferrous sulfide are critically reviewed by comparing data from nine laboratory and anoxic basin studies. A new operational solubility product overcomes some of the ational solution product overcomes some of the problems encountered during comparisons of waters with different ionic strengths. The solubility products corrected to zero ionic strength vary from 2.06 to 4.79 in waters where FeS precipitation is suspected. This suggests that the residence time of particulate FeS in the water may influence time of particulate FeS in the water may influence solubility. For example, in the deep, permanently anoxic Black Sea, there may be a long residence time during which the particulate matter can age and become less soluble. The solubility product, 3.85, approaches that of mackinawite (4.1), which ages to a metastable sulfide, greigite. Both forms have been identified in the Black Sea sediments. Solubility of FeS in shallow, well-mixed basins approaches that of freshly precipitated amorphous FeS. Other possible reasons for the range of solubility products repeated in the literature are: FeS. bility products repeated in the literature are: FeS saturation is not reached in all bodies of water, and experimental methods are not adequate. (Cassar-FRC) W81-03861

CHEMICAL REACTIONS OF SEAWATER WITH ROCKS AND FRESHWATER: EXPERIMENTAL AND FIELD OBSERVATIONS ON BRACKISH WATERS IN ISRAEL, Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.

A. Nadler, M. Magaritz, and E. Mazor.

Geochimica et Cosmochimica Acta, Vol 44, No 6, p 879-886, 1980. 4 Fig, 2 Tab, 56 Ref.

Descriptors: \*Coastal aquifers, \*Saline aquifers, \*Chemical reactions, Rocks, Aquifers, Carbonate aquifers, Brackish water, Sulfates, Magnesium, Calcium, Sodium, Seawater, Geohydrology, Freshwater, \*Israel.

The four major processes governing seawater reactions with rocks in the coastal aquifer of Israel are Ca(2+)-Mg(2+) exchange, Na+-Ca(2+) or Na+-Mg(2+) base exchange, sulfate reduction, and dilution by freshwater. Pure solutions of CaCl2, MgCl2, and NaCl and natural seawater were allowed to react with various rock and mineral samples (limestone, calcite, calcitic dolomite, dolomite, and monomorillonite) for up to 130 days. with MgCl2 solutions and seawater, Ca(2+) and Mg(2+) concentrations were negatively correlated and time-dependent. With CaCl2 the opposite occurred, and the reaction was slower. During base exchange Na+ concentrations decreased; Ca(2+) and Mg(2+) concentrations increased sharply in the first 30 days and leveled off after about 60

days. Analysis of waters from boreholes within 1-2 days. Analysis of waters from boreholes within 1-2 km of the sea showed four distinct groups, classified according to ionic ratios of solutions. These corresponded to the four processes previously discussed. In water from boreholes closest (150 meters) to the sea, dilution, but little chemical reaction, had occurred, Mg(2+) depletion-Ca(2+) increase was observed in calcitic rocks but not in dolomite. Na+-base exchange was observed even with the suspected low clay content of the carbonate aquifer. Waters from 1150-2600 meter depths were lower in Na:Cl and Mg:Cl ratios and higher in Ca:Cl ratios than seawater, similar to the com-positions of shallow coastal aquifers. (Cassar-FRC) W81-03862

THE PREDICTION OF MINERAL SOLUBILITIES IN NATURAL WATERS: THE NA-K-MG-CA-CL-SO4-HZO SYSTEM FROM ZERO TO HIGH CONCENTRATION AT 25C, California Univ., San Diego, La Jolla. Dept. of

Chemistry.
For primary bibliographic entry see Field 1B.
W81-03865

DENITRIFICATION AND N2O PRODUCTION IN NEAR-SHORE MARINE SEDIMENTS, Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. Seitzinger, S. Nixon, M. E. Q. Pilson, and S.

Burke. Geochimica et Cosmochimica Acta, Vol 44, No 11, p 1853-1860, 1980. 1 Fig, 3 Tab, 38 Ref.

Descriptors: \*Nitrogen cycle, \*Denitrification, \*Mineralization, Estuaries, Chemical reactions, \*Marine sediments, Sediments, Nutrients, Nitrogen

Evolution of N2 and N2O from undisturbed sediment cores from Narragansett Bay, Rhode Island, was measured in gas-tight chambers. Denitrificawas incastical in gas-tight challenges. Definitions to it too rates for summer temperatures (23C) were on the order of 50 micromol per sq meter per hour for N2 and about 0.2 micromol per sq meter per hour for N2O. This nitrogen flux equals about half the ammonium flux from the sediments and can ac-count for the anomalously low N/P and high O/N ratios frequently reported for benthic nutrient fluxes. N2 evolution rates varied throughout the 30 day experiment, but showed no consistent trends. The first day, rates were high, as the N2 initially dissolved in the pore waters was removed. When the cores were irradiated with 1 million R of gamma radiation, N2 flux was less than 10% of the gamma radiation, N2 flux was less than 10% of the unirradiated experiment, evidence that the N2 evolution was caused by biological production. The approximate composition of nitrogen flux from these sediments to the overlying water was: ammonium, 59%; N2, 29%; dissolved organic nitrogen, 7%; nitrite and nitrate, 4%; and N2O, 0.06%. These findings point to the importance of denitrification in the coastal marine sediments as a nitrogen sink and a limiting factor in primary production. (Cassar-FRC) W81-03866 W81-03866

THE IONIC ASSOCIATIONS IN CONTINENTAL WATERS, (LES ASSOCIATIONS IONI-QUES DANS LES EAUX CONTINENTALES), Office de la Recherche Scientifique et Technique

Ottre-Mer, Paris (France).
J-P, Garmouze, X. Lazzaro, and G. Llanos.
Cahiers O.R.S.T.O.M., Serie Hydrobiologie, Vol
13, No 1/2, p 3-34, 1979-1980. 14 Fig, 20 Tab, 14

Descriptors: \*Inorganic compounds, \*Lakes, \*Mathematical studies, Carbon dioxide, Gypsum, Calcite, Solutes, Saturation, Lake Chad, Bolivia, Chemical interference, \*Dissolved solids.

Different kinds of waters, including 4 samples from the Lake Chad system with conductivities of 225, 450, 800 and 1250 micromhos and 4 from Lakes Titicaca and Poopo with conductivities of 510, 1400, 22000 and 65000 micromhos, were examined in a study of the ionic associations in continental waters. In these waters, the ionic associations which were considered mainly concern CaCO3,

#### Use Of Water Of Impaired Quality-Group 3C

CaSO4, MgCO3 and MgSO4, and modify the developmental conditions of some physical and chemical processes in the medium. The effects of ionic associations were studied for three processes: the regulation of dissolved CO2 and the atmosthe regulation of dissolved CO2 and the atmospheric CO2 pressure, and the precipitation of calcite and of gypsum. For concentrated waters, introduction of a correction for ionic associations may be very important. The regulation of dissolved CO2 via the atmospheric CO2 pressure is greatly affected by ionic associations when the salinity is > or = 500 micromhos, and calculations require corrections for this effect. The conditions for calcite precipitation are usually profoundly modified by ionic associations of Ca(2+) and CO3(2-) ions, which usually appear as CaCO3, CaSO4 and MgCO3, leading to an overestimation of the product of ionic activities, and the calculations for calcite precipitation require corrections. tions for calci in rolling activities, and the calculations for calcite precipitation require corrections. Gypsum precipitation, generally occurring in concentrated water, also requires corrections. Calculation programs were developed which include these corrections. (Hertzoff-FRC)

#### 2L. Estuaries

WATER QUALITY EVALUATION - AN ESTUARINE CASE STUDY, Army Engineer Div. South Pacific, San Francisco, CA.

For primary bibliographic entry see Field 5C. W81-03654

OCCURRENCE OF VIBRIO CHOLERAE SER-OTYPE OI IN MARYLAND AND LOUISIANA ESTUARIES,

Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W81-03848

RATE OF MERCURY LOSS FROM CONTAMI-NATED ESTUARINE SEDIMENTS, Geological Survey, Woods Hole, MA. M. H. Bothner, R. A. Jahnke, M. L. Peterson, and

R. Carpenter. Geochimica et Cosmochimica Acta, Vol 44, No 2, p 273-285, 1980. 10 Fig, 4 Tab, 30 Ref.

Descriptors: \*Mercury, \*Estuaries, \*Bellingham Bay, Washington, Industrial wastes, Chemical industry, Sediments, Fluctuations, Bays.

The temporal decrease of total mercury in sediments was monitored at three sites in Bellingham Bay, Washington, near a chlor-alkali plant which is the industrial source of mercury contamination in the area. The sediment samples were analyzed for total mercury by wet chemical oxidation followed by flameless atomic absorption. The observed decrease in total mercury concentrations between 1970 and 1973 sampling data cannot be explained 1970 and 1973 sampling data cannot be explained by dilution of mercury-rich sediment with sediment low in mercury. The concentration of mercury appeared to decrease with a half-time of about 1.3 yr after the primary anthropogenic source of mercury was removed. It is suggested that the removal of mercury is associated with sediment particles transported out of the study area. This decrease was modeled using a steady-state mixing model. Mercury concentrations in anoxic interstitial waters reached 3.5 micrograms/diter, which is 126 times higher than that observed. anoxic interstitial waters reached 3.5 micrograms/ liter, which is 126 times higher than that observed in the overlying seawater. High mercury fluxes were associated with low oxygen levels or reduc-ing conditions in the overlying seawater. No flux was measurable from oxidizing interstitial water having mercury concentrations of 0.01 - 0.06 mi-crograms/liter. (Baker-FRC)

DENITRIFICATION AND N2O PRODUCTION IN NEAR-SHORE MARINE SEDIMENTS, Rhode Island Univ., Kingston. Graduate School of Oceanography.

For primary bibliographic entry see Field 2K.

W81-03866

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

#### 3A. Saline Water Conversion

APPARATUS FOR DESALINATING WATER, R. E. Diggs.
U.S. Patent No 4,211,609, 18 p, 21 Fig. 7 Ref;
Official Gazette of the United States Patent Office,
Vol 996, No 2, p 608, July 8, 1980.

Descriptors: \*Patents, \*Desalination, \*Desalination apparatus, \*Solar radiation, Separation techniques, Evaporation, Water vapor, Distillation, Vacuum

An apparatus and method for removing contaminants from water is described. Contaminated water flows across a grid and into a storage tank. The grid utilizes solar energy to heat that water to a predetermined temperature. A heat transfer struc-ture which is dome-shaped and receives water from the storage tank and a preheater means utiliz-ing solar energy heats the water to a further predetermined temperature. An evaporator means re-ceives the heated water and exposes it to a vacuum condition so that the temperature of the water is condition so that the temperature of the water is above the saturation temperature. The water is thus vaporized, and solid contaminants dissolved therein are separated. The solids are deposited on moving belts and are moved into a solids removal system. The solids removal system comprises trap door pairs upon which the solids are deposited and which are sequentially opened to that the vacuum conditions existing in the evaporator are not disturbed. Vapor transferring means removes the water vanor from the evaporator and transfers it to water vapor from the evaporator and transfers it to water vapor nom the evaporator and transfers it to the heat transfer structure where it is condensed to form distillate which is free of solid contaminants. Distillate removal means then removes the distil-late from the heat transfer structure to collection or usage means. (Sinha-OEIS)

REVERSE OSMOSIS MEMBRANE, Matsushita Electric Industrial Co., Ltd., Kadoma Matsushita Electric Industrial Co., 2005, (Japan), (Assignee), M. Kitano, I. Sumita, and Y. Sakamoto. U.S. Patent No 4,214,994, 8 p, 3 Fig, 8 Tab, 1 Ref. Official Gazette of the United States Patent Office, Vol 996, No 5, p 1793, July 29, 1980.

Descriptors: \*Patents, \*Desalination, \*Membranes, \*Semipermeable membranes, Water treatment, Sea water, Desalination apparatus, Flow rates.

In a reverse osmosis membrane of the structure of In a reverse osmosis membrane of the structure of Loeb's membrane for use to purify sea-water into plain water, the membrane comprises a skin layer as an active layer and a gel layer supports the skin layer. An improvement of flux, that is the (passing rate of purified water) is achievable by burying a porous sheet, such as plain-woven cloth or non-woven fabric, in the gel layer. The porous sheet is preferably a plain-woven cloth having only a small elasticity, namely taffeta, sheer or gauze or of non-woven fabric of small elasticity. A suitable thickness of the porous sheet depends on the type of ness of the porous sheet depends on the type of weaving, material yarn and size of the membrane, but in general, the thinner the gel layer is the thinner the sheet must be, in order that the porous sheet is entirely buried in the gel layer. (Sinha-OEIS) W81-03699

#### 3B. Water Yield Improvement

ASSESSMENT OF METHODOLOGY RE-QUIRED TO QUANTIFY IRRIGATION RETURN FLOWS,

Montana State Univ., Bozeman. Dept. of Civil

Moltana State Charl, Engineering.
M. E. Nicklin, and R. L. Brustkern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-218299, Price codes: A03 in paper copy, A01 in microfiche.

Montana Water Resources Research Center, Monp, 5 Fig. 15 Ref. OWRT A-120-MONT(1), 14-34-0001-9028.

Descriptors: "Irrigation-return flow, "Literature review, Statistical methods, Hydrologic models, Surface-groundwater relations, Semiarid climates, Methodologies, Quantification, Beaverhead River.

Good water management requires that all available water in a stream-aquifer system be properly ac-counted for. In the semiarid West the major water demand is for agricultural irrigation. Significant portions of diverted irrigation water return to the portions of diverted irrigation water return to the stream. The amount and timing of irrigation return flow is difficult to quantify. The study's goals were (1) to identify the existing methodologies for return flow quantification, and (2) to suggest potential field sites that might be appropriate for field testing of the more promising methodologies. An extensive literature review revealed that most methodologies applicable to irrigation return flow methodologies applicable to irrigation return flow analysis are research oriented computer models requiring large amount of hydrologic data for their proper operation. Unfortunately, the data needs are difficult to provide for except in a few site specific instances. The most promising study site identified for methodology evaluation was the Bea-verhead River near Dillon, Montana. Preliminary data analysis suspersts that significant return flows data analysis suggests that significant return flows occur during both the irrigation and nonirrigation season. Statistical procedures may be useful in es-tablishing relationships between irrigation diver-sions and return flows. A more analysis utilizing additional statistical methods is recommended. W81-03724

#### 3C. Use Of Water Of Impaired Quality

INDUSTRIAL WASTEWATER REUSE: COST ANALYSIS AND PRICING STRATEGIES, Montgomery (James M.), Pasadena, CA.
G. P. Treweek, N. Hixson, P. Teigen, and K. Fox.
Available from the National Technical Information Available from the National I ectinical Information Service, Springfield, VA 22161 as PB81-215600, Price codes: A08 in paper copy, A01 in microfiche. Office of Water Research and Technology Report OWRT/RU-80/7, April, 1981. 143 p, 21 Fig. 35 Tab, 19 Ref, 3 Append. OWRT-C-80259-R(No 8817)(1), 14-34-0001-8817.

Descriptors: \*Wastewater renovation, \*Industrial water use, \*Computer models, \*Cost analysis, \*Pricing, Advanced wastewater treatment, Chemical precipitation, Cooling towers, Financial feasi-bility, Market value, Reclaimed water, Regional planning, Scaling, Solubility coefficient.

The reclamation of municipal wastewater and its subsequent reuse is prompted by one or more of the following considerations: (1) Reuse is the next least-cost source' of water of acceptable quality;
(2) Fresh water supplies are scarce, unreliable, or allocated to high quality users; (3) Reuse is the most cost-effective means of effluent disposal; and (4) Public policy encourages or mandates reuse. Planning facilities and preparing cost estimates and pricing strategies for wastewater reclamation and reuse require combining the steps normally associated with both wastewater treatment and water supply. This report discusses the overall planning supply. This report discusses the overall planning procedures for a wastewater reclamation and reuse project, with emphasis on those unique steps not generally associated with a facilities plan. Several computer programs, designed to speed the calculations involved in determining the necessary wastewater treatment steps, the size and cost of reclaimed wastewater delivery systems, and present worth calculations, are presented as a means to simplify the overall planning procedure. The second section of this report deals with the development of pricing strategies for a wastewater recomment of pricing strategies for a wastewater recomment. opment of pricing strategies for a wastewater rec-lamation and reuse project, which often will cross traditional boundaries between fresh water distribution and wastewater collection and treatment.

Also presented are case histories which illustrate
the application of the previously developed com-

#### Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

#### Group 3C-Use Of Water Of Impaired Quality

puter programs and pricing strategies. (See also W81-03602) W81-03601

INDUSTRIAL WASTEWATER REUSE: COST ANALYSIS AND PRICING STRATEGIES: AP-PENDICES

PENDICES,
Montgomery (James M.), Pasadena, CA.
G. P. Treweek, N. Hixson, P. Teigen, and K. Fox.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-215618,
Price codes: A14 in paper copy, A01 in microfiche.
Office of Water Research and Technology Report
OWRT/RU-80/7, April, 1981. 266 p. 14 Fig. 9
Tab, 20 Ref. OWRT-C-80259-R(No 8817)(1), 14-240001-8218.

Descriptors: \*Wastewater renovation, \*Industrial water use, \*Computer models, \*Cost analysis, \*Pricing, Advanced wastewater treatment, Chemical precipitation, Cooling towers, Financial feasibility, Market value, Reclaimed water, Regional planning, Scaling, Solubility coefficient.

Two computer models, CHEMTRT and REUSE, were developed to assist the reuse planner in analyzing the water quality and quantity constraints in lyzing the water quality and quantity constraints in developing a wastewater reclamation and reuse project. Program descriptions and listings are presented in this appendix. CHEMTRT is an adaptation of the chemical equilibrium model REDEQL2, which was developed by Drs. Morel and Morgan at the California Institute of Technology. The model provides for the precipitation of supersaturated species, the complexation of ions, the details of the complexation of the complex the complexation of the complex the complex the complexation of the complex the oxidation and reduction reactions, and adsorption involving some 35 cations and 55 anions. In addition to analyzing the effluent produced from var-ious treatment steps, CHEMTRT can model the chemical reactions important in cooling tower and boiler operations, such as the precipitation of suconter operations, such as me precipitation of su-persaturated species, the complexation of ions, and the effects of temperature and ionic strength on solubility. Following application of CHEMTRT for determination of effluent water quality, emphasis shifts to the REUSE model which is used to screen alternative treatment and distribution systems. In this program, the available effluent quantity is distributed to the known demands of potential users, as provided by market assessment. In the REUSE model, the engineer specifies the existing treatment process steps at the wastewater reclamation plant, any additions to these treatment steps, and any requirements for user pretreatment after receiving the reclaimed effluent. In addition, the engineer specifies the basic physical layout of the distribution system along with reservoir sizing and costing. The REUSE model calculates the treatment and delivery system capacity and cost, through the use of internally stored cost curves. following the calculations, control returns to the engineer who is then able to revise the treatment processes and the physical layout to investigate alternative systems. (See also W81-03601)

PRACTICAL APPLICATIONS FOR REUSE OF WASTEWATER,
Japan Sewage Works Agency, Tokyo.

T. Kubo.

11. Rudo.

In: Proceedings; Seventh United States/Japan
Conference on Sewage Treatment Technology,
May 19-21, 1980, Tokyo, Japan. Environmental
Protection Agency Report EPA-600/9-80-047, December, 1980, p 331-362. 3 Fig, 14 Tab.

Descriptors: \*Water reuse, \*Water resources de-velopment, \*Water supply, \*Municipal wastewater, Water quantity, Water quality, Agri-culture, Industrial water, Economics, Water quality standards, Water rights, \*Japan.

The maximum available water in Japan in a dry year is 333.3 billion cu m, of which 87.63 billion cu m is used, 14% for municipal, 21% for industrial, and 65% for agricultural purposes. Municipal and industrial water demand is expected to increase and the republiking of groundwater use his industrial. and the prohibition of groundwater use by indus-tries and delays in dam construction will put great pressure on water supplies, particularly in the dry season. Water quantity and quality concerns are

not now handled in an integrated manner, but provisions of the Comprehensive Basin Sewerage Plan of Sewerage Act 2-2 address the problem. Water conservation can have the benefits of delaying the need to expand the water supply, and the wastewater treatment facilities. Total municipal wastewater discharge in Japan is 6.17 billion cu m/day of which 0.73 million cu m/day are directly reused in 201 projects by the municipal wastewater treatment plants, and 0.16 million cu m/day are used in 22 projects, mainly irrigation and industrial cooling. Increased agricultural use is considered possible, but it is not intended that the reused water be used as drinking water. The problems to be considered in the direct reuse of municipal wastewater include: water quality standards, economics and energy consumption of the treatment and transport needed; water rights; and psychological unacceptability of water reuse. (Brambley-SRC) SRC) W81-03618

PUBLIC EVALUATION OF WASTEWATER REUSE OPTIONS,
California Univ., Berkeley. Dept. of Social and Administrative Health Services.
W. H. Bruvold, and J. Crook.

W. H. Bruvold, and J. Crook. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-218539, Price codes: A05 in paper copy, A01 in microfiche. Office of Water Research and Technology, Report No OWRT/RU-80/2, October, 1980. 77 p, 29 Tab, 16 Ref, Append. OWRT-R-0015(No 7813)(1), 14-34-0001-7813.

Descriptors: \*Attitudes, \*Public opinion, \*Water reuse, \*Reclaimed water, Public health, Wastewater disposal, Wastewater renovation, Public participation, Social aspects, Planning, Bond issues, Decision making, Environmental policy, Economic aspects, California.

This research assessed how individual sociodemographic and belief variables related to personal attitudes toward reclaimed water, how 140 respondents within each of ten selected California cities ranked and evaluated specific proposed options for reuse or disposal of wastewater, and generalities in option rankings across the ten cities surveyed. Respondents were presented a detailed analysis of three wastewater treatment and reuse options for their community that covered the environmental, health and economic impacts of each option in a balanced and factual manner. Personal attitudes were assessed using a previously developed scale that dealt with the direct reuse of reclaimed water. Younger, more affluent, more highly educated respondents who had previously considered the use of reclaimed water had more favorable attitudes than older, less affluent, less educated respondents who had personally not coneducated responsents who nau personally not con-sidered the use of reclaimed water. Further, re-spondents who believe that there was a water supply shortage, that modern technology was ca-pable of treating wastewater, that public health officials would approve certain uses of reclaimed water, and that using reclaimed water would bene-fit the accompany water wors favorable in their water, and that using rectained water Would bene-fit the economy, were more favorable in their attitudes. Overall, the results showed that respond-ents favored options that protected public health, enhanced the environment, and conserved scarce water resources. W81-03726

RE-UTILIZATION OF MUNICIPAL WASTEWATER SLUDGES - METALS AND NI-

California Univ., Riverside.
For primary bibliographic entry see Field 5E.
W81-03758

IRRIGATION OF CORN WITH MUNICIPAL

IRRIGATION

EFFLUENT,
Florida Univ., Gainesville. Dept. of Agricultural
Engineering.
A. R. Overman.

Transactions of the ASAE, Vol 24, No 1, p 74-76,
80, January-February, 1981. 8 Fig, 3 Tab, 5 Ref.

Descriptors: \*Wastewater irrigation, \*Corn, Trickle irrigation, Irrigation, Nutrients, Land disposal,

Uptake, Nitrogen, Phosphates, Potassium, Agricultural engineering, \*Impaired water use.

A study was performed to obtain information on A study was performed to obtain information on yield response and nutrient recovery of corn silage at two row spacings and various application rates of treated municipal wastewater. Nutrient composition in Kg/ha/cm of the secondary effluent from the trickling filter was Ca 6.4, Na 5.5, Mg, 1.75, N 2.6, P 0.94, K 0.75, Fe 0.12 and Zn 0.035, with an average pH of 7.2 and Cl content of 51 mg/liter. Effluent nitrogen was 52% HN4-N, 10% NO3-N, and 38% organic-N. BOD was 49 mg/L, total solids 303 mg/L and suspended solids 39 mg/L. The corn grew well under effluent irrigation. Yields and nutrient uptake increased with irrigation rate, while dry matter content and nutrient Yields and nutrient uptake increased with irrigation rate, while dry matter content and nutrient content of the silage remained essentially constant. Crop uptake of N, P, and K was slightly higher for the narrow rows except at the lowest irrigation rate of 5 cm/week. Competition from weeds was less at higher irrigation rates and for the narrow rows. Weed control by cultivation or with herbicides would be desirable. (Baker-FRC) W81-03763

SEASONAL GROWTH AND ACCUMULATION OF NITROGEN, PHOSPHORUS, AND POTASSIUM BY ORCHARDGRASS IRRIGATED WITH MUNICIPAL WASTE WATER, Cold Regions Research and Engineering Lab., Hanover, NH.

Journal of Environmental Quality, Vol 10, No 1, p 64-68, January/March, 1981. 4 Fig, 3 Tab, 23 Ref.

Descriptors: \*Wastewater irrigation, \*Essential nutrients, \*Orchardgrass, \*Water reuse, Wastewater, Nitrogen, Phosphorus, Irrigation, Spray irrigation, Nutrients, Wastewater renovation, Wastewater management, Wastewater disposal, \*Impaired

water use.

This study was designed to identify the peak growth and nutrient accumulation periods of a forage grass irrigated with municipal waste water. The site was prepared and seeded in August 1977 with orchardgrass. During soil preparation 3 metric tons/ha of dolomite limestone and 50 and 100 kg/ha of N and K, respectively, were added. Domestic sewage from the town of Hanover was given primary treatment and applied by spray irrigation from May to October in 1978 and from May to September during 1979. Waste water was applied at a rate of 7.5 cm/week. Sufficient amounts of N and P were supplied by the waste water applications to avoid nutritional deficiencies of these elements which would have disrupted growth of the plants. Dry matter accumulation for both years leveled off after 31 days of growth during the lirst harvest period. There were no 1978 and 1979. For maximum yields and nutrients removal, it is suggested that orchardgrass be initially harvested at the early heading stage of tially harvested at the early heading stage of growth in the spring. Subsequent harvests should be performed at 5- to 6-week intervals. Since the be performed at 5- to 6-week intervals. Since the average daily dry matter, N and P accumulation were highest during the first harvest period, it is suggested that this time would be ideal for increasing the application rate, thus using the excess waste water which otherwise would have to be stored during the winter season. (Baker-FRC) W81-03828

INTERACTION BETWEEN HIGH LEVELS OF APPLIED HEAVY METALS AND INDIG-ENOUS SOIL MANGANESE, Science and Education Administration, Beltsville, MD. Fruit Lab.

R. F. Korcak, and D. S. Fanning. Journal of Environmental Quality, Vol 10, No 1, p 69-72, January/March, 1981. 3 Tab, 11 Ref.

\*Plant Descriptors: \*Manganese, disposal, \*Heavy Wastewater, Zinc, Copper, Cadmium, N Wastewater renovation, Land dis Wastewater management, \*Impaired water us Nickel disposal,

High levels of Mn found in the tissues of plants grown on soils treated with sewage sludges were

#### WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

#### Conservation In Agriculture—Group 3F

investigated. Twelve soil materials were used in the study. Six of these were surface and six, subsurface samples. The soils were amended with varying rates of a composite of Cd, Cu, Ni, and Zn ing rates of a composite of Cd, Cu, Ni, and a sulfate salts at rates equivalent to the total amounts of these metals present in a digested sewage sludge, applied at a rate of 224 dry metric tons/ha. With the application of Cd, Cu, Ni, and Zn as metal salts the application of Cd, Cu, Ni and Zn as metal salts. or as sewage sludge, the plant tissue levels of Mn increased. The increases in Mn content were greater in unlimed than in limed soils. The elevation of er in unlimed than in limed soils. The elevation of Mn levels was directly related to the indigenous levels of soil Mn. It is noted that the obvious relationship between rate of heavy metal application and indigenous soil Mn may influence procedures and policies regarding dispositin of waste. (Baker-FRC) W81-03829

BIOMASS PRODUCTION ON SANDY DE-SERTS USING HIGHLY SALINE WATER, Karachi Univ. (Pakistan). R. Ahmad, and Z. N. Abdullah. Biotechnology and Bioengineering, Vol 22, No 10, (Symposium), p 121-124, 1980. 2 Tab, 5 Ref.

Descriptors: \*Deserts, \*Saline water, \*Irrigation water, Crops, Biomass, \*Impaired water use, Plant growth, Sand, Arid lands, Karachi, \*Pakistan, Agriculture, Halophytes, Sugar beets, Wheat, Cotton, Corn. Potatoes

Irrigation water equivalent in salinity to half that of sea water was used to produce crops in desert sand. The techniques and chemical additives used were described in previous papers. Crops and their optimum salinity of irrigation water were as follows: cotton seeds and lint (M-100 variety), 4000. lows: cotton seeds and intr (M-100 Variety), 4000 ppm; maize foliage, 1200 ppm, with better results at 3600 and 6800 ppm than at 0 ppm; sugar beet foliage and tubers, 4000 ppm, with better results at 8000 and 12000 ppm than at 0 ppm; wheat seeds, 2000 ppm, with acceptable production at 4000 ppm. Crops which decreased in production with any salinity increases over 0 ppm were cotton (D-9 variety), maize seeds, and potato tubers. (Cassar-FRC) W81-03913

#### 3D. Conservation In Domestic and Municipal Use

THE IMPACT OF BEHAVIORAL FACTORS ON RESIDENTIAL WATER CONSERVATION, Oklahoma State Univ., Stillwater. Coll. of Business

Oklahoma State Univ., Stillwater. Coll. of Business Administration.
J. C. Mowen, and R. D. Middlemist.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215659, Price codes: A05 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute, Oklahoma State University Project Completion Report, December, 1980. 71 p, 6 Fig. 8 Tab., 74 Rel, 2 Append. OWRT-C-90220-C-(No 9450)(1), 14-34-0001-9450.

Descriptors: Behavior, Urban planning, \*Water conservation, \*Water supply, \*Water scarcity, \*Surveys, \*Water use, Water deficit, Human population, Conservation, Water demand, Water shortlation, Conservation, water demand, water snort-age, Water allocation, Resource allocation, Water measurement, Water metering, Water manage-ment, Resources management, Water require-ments, Drinking water, Potential water supply.

This study was an initial effort in establishing an understanding of the behavioral factors influencing water consumption, was conducted in Stilwater, Oklahoma, where a temporary water shortage ex-isted, and was conducted in three stages (experiisted, and was conducted in three stages (experimental), pre- and post-experimental). It tested the efficacy of several practical approaches that would be implemented by water agencies to achieve temporary reductions in residential water consumption during short-term water shortages. The complete factorial field experiment tested the effects of three variables on water consumption of 200 randomly-selected families: (1) informed/not informed regarding their weekly water use; (2) given/not given a weekly reminder to conserve water; (3)

either one adult or the entire family signed a pledge to reduce their water consumption by 10%. The major finding revealed that use of either (1) or (2) reduced water consumption by 14.424.6%, but use of (1) and (2) together failed to reduce water consumption. Implications of the results of this study for municipalities in their water planning efforts are discussed. (Zielinski-IPA) W81-03607

#### 3F. Conservation In Agriculture

URBAN LAWN IRRIGATION AND MANAGE-MENT PRACTICES FOR WATER SAVING WITH MINIMUM EFFECT ON LAWN QUAL-

Colorado State Univ., Fort Collins. Dept. of Agronomy. For primary bibliographic entry see Field 7B.

PROTECTIVE HOUSING FOR IRRIGATION SPRINKLERS.

Anthony Mfg. Corp., Azusa, CA. (Assignee). M Choi

U.S. Patent No 4,212,426, 6 p, 4 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 901, July 15, 1980.

Descriptors: \*Patents, \*Irrigation, \*Sprinkler irrigation, Application equipment, Irrigation efficiency, Irrigation operation.

A protective housing is provided which entirely encloses an impact drive irrigation sprinkler to prevent adjacent vegetation from interfering with normal operation of the sprinkler and to minimize damage due to vandalizing. In the case of poputype sprinklers, a lower portion of the housing is tapered to enhance the ability of the sprinkler to move axially through vegetation, such as ivy and the like, and the housing is arranged to entirely enclose the sprinkler in all operating and non-operating positions. (Sinha-OEIS)

#### SPRINKLER CONTROL VALVE.

F. N. Palma. U.S. Patent No 4,210,169, 6 p, 11 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 996, No 1, p 113, July 1, 1980.

Descriptors: \*Patents, \*Sprinkler irrigation, \*Application equipment, Irrigation practices, Irrigation efficiency, Flow control, Valves, Water delivery.

A control valve for a water sprinkler has a passage through it and a rotary member under the control of a stepping motor or equivalent rotatable to increase and decrease the area of the passage. A sensor detects the output pressure at the valve and at a predetermined pressure reverses the direction of rotation of the stepping motor and rotary member. The valve is designed to progressively meter increasing amounts of water until the upper output pressure is reached, then progressively meter decreasing amounts of water until a lower output pressure is reached and then to repeat the cycle. It is necessary, in order for such a valve to operate in conjunction with the supply pump and the sprinkler head, that the predetermined upper output pressure at the valve be less than the pump rating and greater than the pressure required at the increase and decrease the area of the passage. A output pressure at the valve be less than the pump rating and greater than the pressure required at the sprinkler head to cause the latter to reorient itself. The valve, operating in this way, delivers to the sprinkler head, water with a regular and predictable pattern of pressure variation and pressure maximum. This allows predictable operation of the sprinkler head and predictable water delivery at each position. (Sinha-OEIS) W81-03685

#### IRRIGATION VALVE DEVICE,

U.S. Patent No. 4,214,701, 11 p, 8 Fig, 1 Ref; Official Gazette of the United States Patent Office, Vol 996, No. 5, p 1698, July 29, 1980.

Descriptors: "Patents, "Irrigation, "Irrigation prac-tices, Irrigation efficiency, Application equipment, Irrigation operation and maintenance, Valves, Drip irrigation, Swellable material.

An irrigation valve device includes a swellable member and a support to permit moisture to reach the swellable member. Part of the support can be buried in the ground to an adjustable extent to vary the amount of moisture reaching the swellable member. The swellable member acts on irrigation water in response to the degree of swelling. The swellable member is of plastic material, particularly polyurethane gel. Polyurethane gel has an extraordinarily large swellability so that even very small swellable members can bring about large valve-actuating distances and forces. Desirably, the swellable material is accommodated in a perforated sleeve serving as the valve member and acts on a pinchable hose which is passed through the sleeve. By inserting the sleeve in the earth to a greater or smaller extent, one then obtains an effect of adjustment that is similar to that with a wooden swellable member. (Sinha-OEIS) An irrigation valve device includes a swellable

DITCH WATER CLEANING APPARATUS. For primary bibliographic entry see Field 8A. W81-03696

DRIP LEVEL IRRIGATION, Hydro-Plan Engineering Ltd., Tel Aviv (Israel).

N. Menougar. U.S. Patent No 4,215,822, 10 p, 14 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 137, August 5, 1980.

Descriptors: \*Patents, \*Irrigation, \*Application equipment, Irrigation practices, Irrigation efficiency, Flow control, \*Drip irrigation.

The invention is based on the results of an analysis of the factors which govern the attaining of an adequate pressure loss by flow through an emitter unit of a liquid, initially at an elevated supply pressure, and its being subjected to successive encounters with resistance elements. The emitter unit counters with resistance elements. In e-mitter unit comprises a wall defining an elongated flowpath, an inlet and an outlet for the unit, a connector for coupling the unit to an irrigation installation, and two sets of oppositely directed baffles projecting into the flowpath. The baffles of one set are respectively directed towards the inter-baffle regions of the opposite set, and the tip of each baffle is substantially aligned with the tips of the opposite pair of adjacent baffles. (Sinha-OEIS)

#### ASSESSMENT OF METHODOLOGY RE-QUIRED TO QUANTIFY IRRIGATION QUIRED TO QUANTIFY IRRIGATION RETURN FLOWS, Montana State Univ., Bozeman. Dept. of Civil

For primary bibliographic entry see Field 3B. W81-03724

#### WIND-POWERED IRRIGATION TAILWATER SYSTEM: SIZING THE WIND TURBINE AND STORAGE PIT, Kansas State Univ., Manhattan. Dept. of Agron-

Omy.
L. J. Hagen, and M. Sharif.
Transactions of the ASAE, Vol 24, No 1, p 103106, 112, January/February, 1981. 6 Fig, 2 Tab, 14
Ref.

Descriptors: \*Irrigation, \*Wind, Computers, Simulation, Runoff, Pumping, Turbines, Pump turbines, Water reuse, \*Wind-powered turbine.

Factors to be considered in developing a successful wind-powered irrigation tailwater system are rewind-powered irrigation tailwater system are re-viewed. Specifically one must select an operational mode of the wind turbine and pump, a method for conveyance and application of the tailwater, and the size of wind turbine and storage pit to be used. All the choices are interdependent. Computer sim-

#### Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

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ulation was used in this report to aid in sizing the wind turbine and storage pit of a wholly wind-powered system. Long-term relationships among the monthly runoff volume, runoff pumped, wind turbine pumping capacity, and pit storage capacity were determined for western Kansas. The wind were determined for western Kansas. The wind turbine pumping capacity during July and August averaged 0.5 liters per second per square meter of swept area of wind turbine with a 5 m head. However, the ratio of runoff pumped to runoff volume depended on wind turbine size relative to volume depended on wind turbine size relative to runoff volume and pit capacity. An increase in pit storage capacity from 5 to 15% of monthly runoff volume increased this ratio by 5 to 8%. Since the pit was occasionally empty, runoff pumped volume was usually less than the wind turbine pumping capacity. Daily cyclic variations in runoff did not change the ratio of runoff pumped to runoff volume significantly, but stopping runoff for up to 10% of the month when the pit was full increased the ratio by 3-6% at Dodge City. (Baker-FRC) W81-03762 W81-03762

COMPUTER SIMULATION AND MAPPING OF MONTHLY IRRIGATION REQUIRE-MENTS.

Hawaii Univ., Honolulu. Dept. of Agricultural En-

gineering.
K. P. Yang, W. Wong, and T. Liang.
Transactions of the ASAE, Vol 23, No 6, p 1468-1472, November/December, 1980. 8 Fig, 1 Tab, 7

Descriptors: \*Simulation analysis, \*Irrigation practices, \*Mathematical models, Mapping, Hydrologic budget, Computer models, Forecasting, Irrigation efficiency, Model studies, Oahu, \*Hawaii, Soil moisture, Hydrology, Agriculture, Runoff.

Monthly irrigation requirements for the island of Monthly irrigation requirements for the island of Oahu, Hawaii, were simulated by computer. The system produces maps of irrigation requirements and surface runoff for each of 68 areas. One example is presented in the paper. A symbol on the map for each 4 hectare area indicates the monthly irrigation requirement. Items comprising the data base were island code, map number, x and y coordinates, hydrographic area, state boundary, ownership, present use, precipitation, elevation, and soil physical properties. (Cassar-FRC) W81-03768

COMPUTER SIMULATION OF SPRINKLER IRRIGATION PRACTICES FOR MINNESOTA,

Department of Agriculture, Morris, MN.
A. S. Dylla, H. Shull, and D. R. Timmons.
Transactions of the ASAE, Vol 23, No 6, p 1419-1423, November/December, 1980. 3 Fig, 1 Tab, 12

Descriptors: \*Irrigation practices, Computers, \*Sprinkler irrigation, Droughts, \*Minnesota, Soil moisture, Corn, Agriculture, Crops.

Sprinkler irrigation practices for droughty, sandy soils in west central Minnesota were simulated by computer. Best results in growing corn were ob-tained by consistent uniform application of small amounts of irrigation water within two days time or less when the soil moisture deficit was about 40% of the available water capacity. This mini-mized percolation and nitrate leaching losses into the groundwater aquifer and allowed for probable rainfall after irrigation. A table lists the irrigation ramail after irrigation. At alose hists the irrigation thresholds (41 and 25 mm), distribution uniformity coefficients (0.85, 0.75, and 0.65), net irrigations (64, 12.7 and 25,4 mm), irrigation times (1, 2, or 4 days), seasonal percolation, annual irrigation amount, percentage drought area, and average drought days included in the simulation. (Cassar-W81-03770

COMPUTERIZED SCHEDULING OF COM-PLEX IRRIGATION SYSTEMS, Technion-Israel Inst. of Tech., Haifa. Dept. of

Agricultural Engineering.

I. Amir, E. Gofman, S. Pleban, D. Nir, and M.

Transactions of the ASAE, Vol 23, No 6, p 1413-1418, 1423, November/December, 1980. 2 Fig. 5

Descriptors: \*Computer programs, \*Irrigation, \*Agriculture, Sprinkler irrigation, Water conveyance, Water demand, \*Irrigation scheduling, Case studies, Cotton, \*Israel.

An interactive computerized aid to preparing hy-draulic-checked irrigation time tables is presented. It is constructed as a tree of paths, each path being It is constructed as a tree of paths, each path being comprised of several options. At every stage of the searching process, the computer presents alternatives and the farmer chooses the path appropriate to his needs. The system is applied to a case study-a sprinkler irrigating a 58 hectare cotton field in Israel. After introducing the number and nature of pipes, nodes, pumps, and sources, the network solver was calibrated by comparing observed and calculated local head losses. Plans for a 12-day program were evaluated, and it was decided that an 11 day irrigation with a 'dry day' for pump. program were evaluated, and it was decided that an 11 day irrigation with a 'dry day' for pump maintenance was optimum. The computer solution showed several areas where the network needed improvements, which, when implemented, resulted in a 10-day interval. (Cassar-FRC) W81-03772

LOWER KHALIS IRRIGATION PROJECT -

IRAQ, ICI Fibers (England). For primary bibliographic entry see Field 8A. W81-03915

#### 4. WATER QUANTITY MANAGEMENT AND CONTROL

#### 4A. Control Of Water On The Surface

RIVERINE CASE STUDY - COLUMBIA RIVER, Army Engineer Div. North Pacific, Portland, OR. R. J. Hopman.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 19. 11 p, 9 Ref.

Descriptors: \*Channel improvement, \*Dredging, \*Waste disposal, \*Flow-lane disposal, Rivers, Erosion control, Groins, Environmental effects, \*Columbia River.

A concept of placing Columbia River dredged material in water near the channel has been devel-oped with the idea there would be less adverse impact on uplands, wetlands and aquatic life forms and the associated fisheries. Flow-lane disposal or flow-lane dispersion are the terms used to refer to this concept. In general, flow-lane disposal has been limited to the same bar or reach of river and depths of water. Disposal into 20 to 40 ft of water is of utmost importance, because of adverse biological impacts in shallower depths, and excessive erosion in depths greater than 40 ft. Flow-lane disposal was found to be environmentally sound for clean dredge materials. Placement of dredged materials into strategically selected flow-lane disposal areas can prevent erosion to banklines, is-lands, and the river bed itself. Flow-lane disposal could produce material for temporary submerged groins. The effectiveness of submerged groins in providing increased water depth, although tempo-rary, without the normally required dredging and disposal operation may someday prove exciting both as a means of reducing channel maintenance costs and lessening environmental concerns associated with dredging operations. (Moore-SRC) W81-03655

FOUR RIVER BASIN PROJECT,

Army Engineer District, Jacksonville, FL. M. G. Davis.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida.

Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 25. 5 p.

Descriptors: \*Flood control, \*Flood-control storage, \*Water supply development, \*Water resources development, foroundwater, Water conservation, Canals, Water quality, River basin development, Florida, Oklawaha River, Withlacoochee River, Hillsborough River, Peace River.

The Four River Basins Project in Florida was authorized in 1962. The flood control project was named after the four major rivers within the project area: the Oklawaha, Withlacoochee, Hilsborough, and Peace Rivers. These streams and their tributaries drain about 6,100 sq mi. Also included were plans to solve special area problems at Lake Tarpon, the Anciote River and Masarytown. The project addresses the majority of the area-wide flood problems through flood detention areas strategically located in the Hillsborough, Withlacoochee, and Little Withlacoochee Rivers and their tributaries. Through the use of levees and control structures, flood waters can be intercepted and temporarily detained until the river levels downstream recede. Much has been accomplished since work began in 1966, but much remains to be done. work began in 1966, but much remains to be done. Recently a new study was conducted to determine if the Four River Basins Project could be modified or extended to include water supply. Based on future needs, 17 promising alternatives were identified. Two composite plans were developed from the 17 alternatives to supply needed water for the area through 2035. (Moore-SRC) W81-03659

#### 4B. Groundwater Management

WATER SUPPLIES GROUND WATER IN EASTERN NIGERIA, Nigeria Univ., Nsukka. Dept. of Civil Engineering. Aqua, No 9/10, p 11-13, 1980. 2 Fig, 4 Tab, 5 Ref.

Descriptors: \*Groundwater, \*Nigeria, \*Water supply, Potential water supply, Water supply de-velopment, Groundwater mining, Water resources development, Boreholes, Wells.

Groundwater supplies are seen as the only economical method of meeting the water supply needs of the communities of the Anambra State in eastern Nigeria both now and in the future. Groundwater is exploited naturally through springs and artificially through boreholes and shallow wells. The occurrence and distribution of groundwater in the state are related to the geological formations. Most of the state is underlain by sedimentary rocks. Physical, chemical and biological characteristics of samples from some boreholes are detailed. In genraystat, tremter and objects characteristics or samples from some boreholes are detailed. In gen-eral, water from deep boreholes meets the WHO standards for drinking water. Water from deep boreholes is soft and acidic, and iron occurs in high amounts in some areas. The water from shallow wells is generally polluted. The water frequently appears clear and attractive for human consumpappears clear and attractive for human consump-tion, but waterborne disease is endemic, including infective hepatitis, bacillary and amoebic dysen-tery, and diarrhea. Wells are frequently located near pit latrines, soakaway pits and refuse dumps. Improved sanitation measures should reduce such pollution. (Baker-FRC) W81-03917

#### 4C. Effects On Water Of Man's Non-Water Activities

CHANGES IN STREAMFLOW FOLLOWING TIMBER HARVEST IN SOUTHWESTERN OREGON,

OREGON,
Pacific Northwest Forest and Range Experiment
Station, Corvallis, OR. Forestry Sciences Lab.
R. D. Harr, R. L. Fredriksen, and J. Rothacher.
Forest Service, Pacific Northwest Forest and
Range Experiment Station, Portland, Oregon, Research Paper PNW-249, February, 1979. 23 p, 12
Fig, 6 Tab, 26 Ref.

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Identification Of Pollutants-Group 5A

Descriptors: \*Streamflow, \*Logging, \*Clear-cut-ting, \*Water yield, Overland flow, Forest manage-ment, Flood peak, Seasonal distribution, Soil com-paction, Soil erosion, Soil water, Forest watersheds, \*Oregon.

Changes in streamflow after complete clearcutting, small patch clearcutting, and shelterwood cutting were determined for three small watersheds in southwestern Oregon. The first year increase in annual yield was 36 cm (39%), and increases averaged 29 cm (43%) for 5 years in a watershed that was completely clearcut. Increases averaged 6-9 cm (8-14%) in the other logged watersheds. Largest absolute increases occurred in winter, whereas largest relative increases generally occurred during fall and summer when maximum differences in soil water content existed between cut and uncut watersheds. Increases in size of instantaneous peak water content existed between cut and uncut watersheds. Increases in size of instantaneous peak flow appear related to the proportion of a watershed where soil had been compacted during loging and slash disposal. Size of peak flow was increased most in the shelterwood cut watershed where soil was compacted on about 13% of the area. Effects of soil disturbance on peak flow may have significance for erosion and for culvert design in headwater areas and for sedimentation downstream, but probably are of little importance for flooding of lowlands downstream. Increases in annual water yield under sustained yield forest management will not augment water supplies appreciably in southwestern Oregon.

STREAMFLOW AFTER PATCH LOGGING IN SMALL DRAINAGES WITHIN THE BULL RUN MUNICIPAL WATERSHED, OREGON, R. D. Harr.

Forest Service, Pacific Northwest Forest and Range Experiment Station Portland, Oregon Re-search Paper PNW-268, March, 1980. 19 p, 13 Fig, 4 Tab, 24 Ref.

Descriptors: \*Logging, \*Streamflow, \*Watershed management, \*Fog, Clouds, Forest watersheds, Low flow, Water yield, Flood peak, Clear-cutting, Evaportranspiration, \*Oregon, Bull Run Municipal

Changes in annual water yield, minimum stream-flow, and instantaneous peak flow are all important in municipal watershed management. If timber cut-ting can increase water yield, then a municipal watershed might be made to yield more water, particularly during the summer period of low flow. Three experimental watersheds were used to deter-mine the effects of patch logging on timing and quantity of streamflow. Annual water yields and size of instantaneous peak flows were not signifi-cantly changed, but low flow decreased signifi-cantly after logging of two small watersheds in cantly after logging of two small watersheds in small clearcut patches totalling 25% of each water-shed's area. The lack of expected increases in annual water yield may involve fog or cloud inter-ception by the forest canopy. Increased flows during summer low flow had been expected because timber cutting would make more water available for streamflow, particularly during the summer when forest vegetation is withdrawing water from the soil, but loss of fog drip may also account for the low flows. (Moore-SRC) W31-03661

LAND-USE HYDROLOGY: SHOALHAVEN, NEW SOUTH WALES,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant For primary bibliographic entry see Field 2A. W81-03713 Industry.

#### 4D. Watershed Protection

SCHEDULING TIMBER HARVEST TO PRO-TECT WATERSHED VALUES, Pacific Northwest Forest and Range Experiment

Station, Corvallis, OR.

In: Proceedings of Interior West Watershed Management Symposium, April 8-10, 1980, Baum-

gartner, D. M., Ed., Washington State University, Pullman, 1981, p 269-280. 6 Fig, 13 Ref.

Descriptors: \*Logging, \*Forest management, \*Forest watersheds, \*Watershed management, Management planning, Timing, Streamflow, Sediment transport, Flood peak, Soil erosion, Water temperature, Landslides.

The Forest Service is attempting to develop techniques for incorporating watershed values into the planning process described by the National Forest Management Act of 1976. Problems associated with the development of such techniques include determining the effectiveness of harvest scheduling for protecting soil and water resources; distinguishing adverse effects caused by how and if an activity is done from effects caused when it is done; and judging the reliability of predictions currently made on how harvest activities affect peak stream made on how harvest activities affect peak stream made on how harvest activities affect peak stream discharge and sediment routing. Adverse effects on soil and water resources include: soil compaction, surface erosion, reduced site productivity, increased stream sedimentation, increased water temperature, increased size of peak stream discharges, and increased occurrence of landslides. Procedures now used to estimate impacts of harvest activities on soil and water resources have weaknesses that on soil and water resources have weaknesses that limit their usefulness in scheduling harvest to pro-tect soil and water resources. Studies on plots and small, experimental watersheds have provided little information that will allow prediction of offsite, or downstream, effects. Larger scale studies are needed on watersheds drained by third and higher order streams. (Moore-SRC) W81-03663

#### 5. WATER QUALITY MANAGEMENT AND PROTECTION

#### 5A. Identification Of Pollutants

AUTOMATIC WATER QUALITY ANALYZERS FOR SEWERAGE SYSTEMS,

Public Works Research Inst., Tokyo (Japan). K. Murakami.

R. Murakami.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 243-261. 3 Fig, 3 Tab.

Descriptors: \*Autoanalyzers, \*Water quality control, \*Monitoring, \*Wastewater treatment, Organic loading, Hazardous materials, Pollutants, Heavy metals, Secondary wastewater, Raw wastewater, Organic carbon, Oxygen demand, \*Japan.

The paper gives an overview of the use of automatic water quality analyzers in sewerage systems in Japan, the outlook for automatic analyzers for in Japan, the outlook for automatic analyzers for organic loading monitoring under the loading regulation system, and the current state of development of automatic monitoring for hazardous substances. Analyzers are available for nineteen parameters. The most frequently used measure DO, PH, sludge density, MLSS, temperature, turbidity, sludge level, conductivity, and residual chlorine. Most of these instruments are used for monitoring Most of these instruments are used for monitoring water quality, and most are considered satisfactory in use. The less frequently used instruments are considered to be less satisfactory, for operation or accuracy reasons. Where organic loading is to be limited, effluent COD loadings are to be monilimited, effluent COD loadings are to be moni-tored. Automatic analyzers available for this pur-pose include COD, TOC, and TOD analyzers and UV photometers. All the instruments show high time ratios of operation with secondary effluent but are less effective with raw sewage. They are subject to clogging, and require frequent cleaning and maintenance. The development of instruments for total cyanide has been completed, and their standard specifications prepared. Field tests have standard specifications prepared. Field tests have been completed for chromium, cadmium and copper, while lead and mercury analyzers are in the development stage. (Brambley-SRC) W81-03629

A CRITIQUE OF BIOASSAYS USED IN EVAL-UATING WATER-QUALITY IMPACTS OF CORPS ACTIVITIES,

CORPS ACTIVITIES, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. R. K. Peddicord. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 21. 8 p, 12 Ref.

Descriptors: \*Bioassay, \*Water quality, \*Algae, \*Sediments, Dredging, Water pollution, Toxicity, Mortality, Environmental effects, Nutrients, Indicators, Aquatic animals.

The primary uses of biassays in the Army Corps of The primary uses of biassays in the Army Corps of Engineers at present are for algal evaluations in reservoirs, and toxicity tests of dredged material. Algae are structurally simplified aquatic plants, which can markedly affect water quality through their significant interactions with other compo-nents of the aquatic ecosystem. Bioassays have been used in an effort to determine the phytoplank-ton limiting nutrient in a water holy so that the ton limiting nutrient in a water body so that the potential effects of changes in a particular constitu-ent can be evaluated. Algal bioassays can measure changes in any of several parameters, the most frequently utilized of which are biomass, chloro-phyll a, respiration and carbon-14 fixation. Dredged material bioassays cannot be considered precise predictors of environmental effects, but must be regarded as quantitative estimators of must be regarded as quantitative estimators of those effects, making interpretation somewhat subjective. In order to avoid adding more uncertainty to their interpretation, the animal bioassays currently used generally utilize mortality as an end point. Most dredged material is considered to be relatively unlikely to cause unacceptable adverse impacts in the water column, so emphasis is placed on the deposited sediment. A benthic bioassay can aid in assessing the potential environmental impact of the solid phase of dredged material and acts as an indirect indicator of chemical toxicity of the sediment. (Moore-SRC) W81-03657

OIL-WATER INTERFACIAL DETECTOR,

U.S. Patent No 4,213,340, 4 p, 2 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 996, No 4, p 1222, July 22, 1980.

Descriptors: \*Patents, \*Water pollution sources, \*Monitoring, Instrumentation, \*Oil-water inter-\*Monitoring, Instrumentation, \*Oil-war faces, Electrical equipment, Oil pollution.

An electrical instrument detects an interface between oil and water in a tank or other area. The instrument has an electrical circuit that includes a conductor to a lower-most probe and another conductor for selective connection to a series of probes at different elevations. In the circuit, a transistor is used to amplify a current; when a base lead of the transistor forms a closed circuit through a series of resistors and in a presence of water between two probes. The resulting current flowing through a collector-emitter junction is sufficient to activate a relay to perform a specific warning and switching functions. (Sinha-OEIS) W81-03686

COMPARISONS OF SEALED DIGESTION CHAMBER AND STANDARD METHOD COD

Texas Dept. of Water Resources, Austin

A. L. Messenger.

Journal of the Water Pollution Control Federation, Vol 53, No 2, p 232-236, February, 1981. 5 Tab, 12

Descriptors: \*Chemical oxygen demand, \*Water analysis, Digestion, Chemical analysis, Mixing, Water quality control, Water properties, Chemical properties, Suspended solids, Spectrophotometry.

Limitations inherent in the 'Standard Methods' de termination of chemical oxygen demand (COD) have led to research to simplify this reflux and titration test. The ampule and rotating ampule methods were used for COD determinations in

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5A—Identification Of Pollutants**

sealed digestion chambers, and results were compared to data from the standard method. The two ampule methods gave good results; however, values from the rotating ampule technique were consistently higher than those obtained from the ampule or standard method COD tests. The ampule or standard method COD tests. The ampule method was precise and better suited for routine laboratory analyses than the other two techniques. In addition, the boiling process in the ampule technique ensured constant mixing of the sample to aid in the digestion of particulate solids. Data used by the Environmental Protection Agency to establish the 'Alternate Method Equivalency' are presented for the determination of COD by the ampule method. (Geiger-FRC) W81-03756

INTERFERENCE IN INORGANIC PHOSPHORUS ANALYSIS OF MEMBRANE-FILTERED SOLUTIONS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils. G. P. Bickford, and I. R. Willett. Water Research, Vol 15, No 4, p 511-512, 1981. 1 Tab. 6 Ref.

Descriptors: \*Phosphorus, \*Membrane processes, \*Colorimetry, Wetting, Inorganic compounds, Membrane filters, Chemical interference, Analytical techniques, Filtration, Separation techniques, Chemical analysis, \*Water analysis.

Membrane filtration is widely used for the removal of solid components from natural waters or soil and sediment extracts prior to analysis. Determina-tions of inorganic phosphorus by two common colorimetric methods were found to be irreprodu-cible in a membrane filtrate. Soil suspension and cible in a membrane filtrate. Soil suspension and Cacl2 solutions were treated by centrifugation, filtering through Whatman No 42 paper, filtering through Gelman TCM-450 membrane, and filtering through Gelman GA6 membrane prior to analysis. The results for inorganic phosphorus in the solutions obtained by the colorimetric methods of Fogg and Wilkinson (1958) and of Murphy and Riley (1962) were significantly lower for filtrates of the GA6 membrane as compared to those for filtrates of the other two membranes and of centifugation. It was concluded that the filtration of filtrates of the other two membranes and of cen-trifugation. It was concluded that the filtration of solutions through a membrane containing a wet-ting agent caused interference in the two colorime-tric methods for inorganic phosphorus and that this effect was due to the release of some substance from the membrane. It is recommended that 'low extractables' membrane filters be used when the filtrate is required for inorganic phosphorus analyfiltrate is required for inorganic phosphorus analyses by these colorimetric methods. (Carroll-FRC) W81-03784

THE USE OF REVERSE PHASE LIQUID CHROMATOGRAPHY FOR STUDYING TRACE METAL-ORGANIC ASSOCIATIONS IN NATURAL WATERS.

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Applied Biochemistry Div. J. Lee.

Water Research, Vol 15, No 4, p 507-509, 1981. 1 Fig. 20 Ref.

Descriptors: \*Gas liquid chromatography, \*Atomic absorption spectrophotometry, \*Trace metals, Organic compounds, Surface water, Acids, Separation techniques, Organic acids, Analytical techniques

The separation and characterization of organic acid compounds, and particularly of a class of naturally occurring polymeric polyelectrolytes, in surface waters is of considerable importance to the understanding of various facets in metal complexation. Although steric exclusion chromatography has proven useful for the evaluation of metalorganic interactions in waters, organic fractions have not been well resolved. The potential of reverse phase liquid chromatography for the separation of high molecular weight natural organics from surface water into fractions of varying polar-ity was demonstrated. Electrothermal atomic absorption spectrophotometry was used for the de-tection of associated cobalt and copper. The metals eluted with the more polar fractions, with no metal being found in later non-polar fractions. This tech-nique allows pre-concentration of the analyte at the beginning of the column, permitting analysis of large volumes of natural water. (Carroll-FRC)

MOMENT METHODS FOR ANALYZING RIVER MODELS WITH APPLICATION TO POINT SOURCE PHOSPHORUS,

West Virginia Univ., Morgantown. Dept. of Chemical Engineering. F. H. Verhoff, and D. B. Baker. Water Research, Vol 15, No 4, p 493-501, 1981. 8 Fig, 2 Tab, 21 Ref.

Descriptors: \*Stream pollution, \*Water pollution sources, \*Model studies, \*Phosphorus, Mathematical models, Orthophosphates, Wastewater facili-

Quantitative analysis of the fate of point source pollutants in streams can be achieved by using moment analysis if the input concentration is perinoment analysis if the input concentration is periodic. Moment analysis techniques can be applied to continually occurring oscillations in concentration such as that associated with orthophosphorus from a sewage treatment plant or to an intentional dump of some material into a stream. The moment analysis permits discrimination among various proposed models and permits estimation of the parameters in the selected model for describing the fate of the substance in the river. Moment analysis was applied to the evaluation of the fate of orthophosphorus entering the Sandusky river from the Buphorus entering the Sandusky river from the Bu-cyrus, Ohio, sewage treatment plant. There were diurnal periodic concentration changes in the efflu-ent flow. Moment analysis was used to discriminate between reversible adsorption in the sedi-ments and the irreversible precipitation or micro-bial utilization in the sediments. It was concluded that the reaction model was consistent with the measurement of moments and that the adsorption model was not consistent. The method of moments model was not consistent. The method of moments was used to quantify various parameters for the irreversible model, including reaction rate constant and the dispersion of orthophosphorus in the river. (Carroll-FRC) W81-03786

AN INTERLABORATORY STUDY OF DIS-SOLVED OXYGEN IN WATER,

Department of Scientific and Industrial Research, Petone (New Zealand). Chemistry Div. R. J. Wilcock, C. D. Stevenson, and C. A. Roberts

Water Research, Vol 15, No 3, p 321-325, 1981. 2 Fig, 2 Tab, 14 Ref.

Descriptors: \*Dissolved oxygen, \*Measuring in-struments, Oxygen, Residual oxygen, Winkler method, Sample preservation, Mercury, Chlorides, Electrodes.

This paper reports the successful application of a preservation technique which will allow interlaboratory studies of dissolved oxygen in water to be carried out. The procedure involves the addition of mercuric chloride to eliminate biological activity and subsequent storage of the sample in gastight glass containers. A reasonable level of performance was achieved in most cases, and between-laboratory variability was about 7-10 times the precision attainable by each method. Results obtained with membrane electrodes were on the average significantly higher than those measured by the Winkler method. The variability among analysts' results suggests that care should be taken when comparing results obtained by different workers, and that too much importance should not be attached to small differences in dissolved oxygen levels without close examination of the oxygen levels without close examination of the methods used. (Baker-FRC) W81-03788

NEW TECHNIQUE FOR LOW-LEVEL CON-

TAMINANT DETECTION.

Journal of the American Water Works Association, Vol 73, No 3, p 38, 40, March, 1981.

Descriptors: \*Chromatography, \*Sample prepara-tion, \*Trace levels, Measuring instruments, Water quality, Pollutants, Column chromatography, Or-ganic compounds, Chemical analysis.

Most existing methods for verifying water quality at the microgram per liter and nanogram per liter levels pose unacceptable contamination, recovery, and sample-loss problems. An inline trace enrichment method for analysis which has recently been developed can overcome these problems by increasing liquid chromatograph sensitivity through concentration by up to 10,000 fold or more. The method utilizes two basic chromatography processes: reversed-phase on-column concentration and two-solvent gradient elution. The sequential execution of these two processes by a computer-controlled liquid chromatograph, which allows programming of sample volume, flow rates, gradients, and hold times, allows researchers and technicians to analyze water samples in low detection limits. Most existing methods for verifying water quality and hold times, allows researchers and technicians to analyze water samples in low detection limits. The two limiting factors which must be considered when using this process are the analysis time for large samples and the sensitivity of the detector to the slightest water or solvent contamination. Initial the slightest water or solvent contamination. Initial tests of the method using a polynuclear aromatic standard solution and water and acetonitrile solvents showed that the technique enables detection of polynuclear aromatics and phenols in water samples in the microgram per liter and nanogram per liter ranges. The trace enrichment method is relatively low in cost, easy to learn, and provides sensitivity equivalent to instruments in the \$150,000 range. (Carroll-FRC) W81-03801

THE OCCURRENCE OF TRIHALOMETH-ANES IN PUBLIC WATER SUPPLY SYSTEMS OF NEW YORK STATE, New York State Dept. of Health, Albany. Div. of Environmental Health Services.

J. S. Schreiber. Journal of the American Water Works Association, Vol 73, No 3, p 154-159, March, 1981. 6 Fig, 4 Tab, 5 Ref.

Descriptors: \*Water quality, \*Drinking water, \*Halogens, Chloroform, Bromine, Chlorination, Water supply, Water conveyance, Seasonal variation, Organic compounds, Water sampling, Municipal water, New York, Trihalomethanes.

The formation of chloroform and other trihalomethane (THM) compounds in chlorinated drinking water supplies has been well documented. In anticipation of the enactment of Federal regulaanticipation of the enactment of Federal regula-tions for the control of organic chemical contami-nants in drinking water, the New York State Bureau of Public Water Supply conducted a state-wide survey to evaluate the degree to which THMs and selected organic chemicals are present in drinking water supplies and the impact of the proposed regulations. The survey measured the four THMs (chloroform, bromodichloromethane, chlorodibrymomethane) as well as trichlorogethy. bromodichloromethane, and chlorodibromomethane, as well as trichloroethylene, tetrachloroethylene, 1,1,1,-trichloroethane, and carbon tetrachloride. A total of 235 routine grab samples from an equal number of public water supplies throughout the state was supplemented by seasonal samples collected from four systems and seasonal samples collected from four systems and investigations conducted on five systems to determine variations within the distribution system. Grab sample analyses showed that 93% of the samples had detectable amounts of bromodichloromethane, 89% had chloroform, 57% had chlorodibromomethane, and 0.47% had bromoform. Only two of the supplies tested had detectable amounts of the other four chemicals. Results from the investigation of the distribution systems showed that the concentrations of chloromy were often highest at the treatment plane. form were often highest at the treatment plant.
Although the highest chloroform levels were generally found in the month of July, January concenerally found in the month of July, January concentrations were also high. A computer program generated scattergrams which plotted THM levels against the following water quality parameters: color, pH, turbidity, prechlorination dose, postchlorination dose, total chlorine dose, chlorine contact time, free chlorine residual, and chlorine demand. No strong positive relationships were found. The impact of the proposed Federal regula-

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Identification Of Pollutants-Group 5A

tions on New York communities will be dependent on the population served and the THM concentra-tions encountered. (Carroll-FRC)

CHRONOAMPEROMETRIC DETERMINA-TION OF FREE CHLORINE BY USING A WAX-IMPREGNATED CARBON ELECTRODE, FMC Corp., Princeton, NJ.

Journal of the American Water Works Associ-ation, Vol 73, No 3, p 150-153, March, 1981. 9 Fig,

Descriptors: \*Chlorine, \*Electrochemistry, Measuring instruments, Pollutants, Water quality, Electrolysis, Chemical reactions, Chronoamperometry, Chemical analysis, Swimming pools.

An analytical method that measures free chlorine instead of total chlorine is necessary to monitor and control swimming pool sanitation. Chronoamperometry with linear potential sweep using a waximpregnated graphite electrode provides a rapid, sensitive, and selective method for measuring free sensitive, and selective metroid for measuring free chlorine. This technique can be used to measure free chlorine alone at sub-milligram-per-liter levels in the presence of chlorinated isocyanurates and cyanuric acid. Being a nondestructive method, it does not disturb the equilibrium between the free and combined chlorine species during the measure. and combined chlorine species during the measurement, thereby providing an accurate measurement of free chlorine concentration. Since it measures of tree chlorine concentration. Since it measures the sum of hypochlorous acid and hypochlorite ion in the solution, the measurement of free chlorine is not affected by pH variations. Tests conducted with sodium dichloroisocyanurate in aqueous solutions demonstrated that the method could successfully measure the free chlorine concentration in the fully measure the free chlorine concentration in the solution and determine the degree of hydrolysis of sodium dichloroisocyanurate. These tests showed that rapid equilibrium establishment takes place in the cyanuric acid-chlorine system, and that the equilibrium controls and distributes the concentra-tion of free chlorine in the solution. (Carroll-FRC)

LEVELS OF HYDROCARBONS IN MUSSELS, MYTILUS EDULIS, AND SURFACE SEDI-MENTS FROM DANISH COASTAL AREAS,

Marine Pollution Lab., Charlottenlund (Denmark).

Bulletin of Environmental Contamination and Toxicology, Vol 26, No 2, p 202-206, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: \*Coastal waters, \*Oil pollution, \*Mussels, Harbors, \*Denmark, Sediments, Hydrocarbons, Coasts, Industrial wastes, Oil wastes, Oil spills, Oily water, Oil industry.

The presence of low level, chronic oil pollution in the marine environment was investigated. The study included three areas which are within refinery effluent range. All the samples came from Panish coastal locations, including both surface sediment samples and samples of blue mussels, Mytilus edulis. The levels of hydrocarbons in the surface sediments fell within a range of two orders surface sculments fell within a range of two orders of magnitude, with the highest levels in areas close to an oil refinery. The study indicated that the major source of hydrocarbons in Danish coastal areas is industrial wastewater. The study shows that the low level input of oil into Danish coastal areas may lead to situations of chronic oil pollution areas may read to studenton to entonice or ponution resulting in high levels of hydrocarbons in mussels and sediments, especially in areas loaded with in-dustrial wastewater, refinery effluent or small spills in an oil harbor. (Baker-FRC) W81-03812

SEASONAL VARIATION OF MUTAGENIC AC-

TIVITY IN DRINKING WATER,
Iowa State Univ., Ames. Dept. of Food Technol-

ogy. S. M. Grimm-Kibalo, B. A. Glatz, and J. S. Fritz. Bulletin of Environmental Contamination and Toxicology, Vol 26, No 2, p 188-195, 1981. 3 Fig,

Descriptors: \*Seasonal variation, \*Drinking water, \*Mutagens, Carcinogens, Des Moines, Iowa, Bioassay, Potable water, Ames test, Organic com-

This study surveys the seasonal changes in mutagenic activity, as measured by the Ames test, of organic contaminants accumulated from raw and organic containants accumulated from raw and finished drinking water. Fifteen water samples were taken from the water supply of Des Moines, Iowa, over the course of one year. Water for this supply is obtained from a river as well as from an supply is obtained from a river as well as from an infiltration gallery in the river valley. The gallery, constructed of segments of concrete cylinders, receives surface water that has percolated through a coarse layer of glacial sand and gravel. Raw water was sampled after sand-gravel filtration and chemical treatment. Finished water was sampled after final chlorination and fluoridation. A high mutacenic activity was measured in water during the genic activity was measured in water during the late summer and fall samples, which may be due to carry-over of organic material accumulated over carry-over of organic material accumulated over the spring and summer within the filter beds of the treatment plant. Mutagenic activity during the winter may be due to chlorinated or nonchlorinat-ed pollutant chemicals introduced into the raw water throughout the year. Mutagenic activity was detected more often and at higher levels in finished detected more other and at ingher levels in liminate than in raw water. However, these particular samples contained relatively low mutagenic activity. Improved methods of water treatment and alternatives to chlorination should, however, be sought so as to lower the levels of potentially harmful con-taminants in drinking water. (Baker-FRC) W81-03815

AN INTRALABORATORY COMPARATIVE STUDY OF HYDRIDE GENERATION AND GRAPHITE FURNACE ATOMIC ABSORP-TION TECHNIQUES FOR DETERMINING OR-GANIC AND INORGANIC ARSENIC IN COM-

GANIC AND INORGANIC ARSENIC IN COM-PLEX WASTEWATERS, Benedict Coll., Columbia, SC. Dept. of Chemistry. J. T. Kinard, and M. Gales, Jr. Journal of Environmental Science and Health, Vol A16, No 1, p 27-50, 1981. 10 Fig, 11 Tab, 13 Ref.

Descriptors: \*Arsenic, \*Wastewater composition, \*Pollutant identification, Analytical techniques, Atomic absorption spectrophotometry, Photo-metry, Spectral analysis.

Two hydride generation techniques were used to obtain a comparison of the determination of arsenic ordan a companion of the electrimator of assente in complex wastewater samples through hydride generation and graphite furnance atomic absorp-tion. In one method of hydride generation, sodium borohydride pellets were used with argon to sweep the arsine into a hydrogen flame. In the second method arsine was produced from a sodium borohydride solution and swept into an air-acetylene heated quartz tube. Consistent, reliable data were obtained by these techniques for highly complex wastewater only when arsine generation was pre-ceded by a closed acid digestion process. The ceded by a closed acid digestion process. The graphite furnance technique allowed 99% recov graphite turnance technique antowed year feetowery of the arsenic. The degree of complexity of the wastewater was not a factor, nor was the presence of organic forms of arsenic a problem with this technique. While both methods are suitable, the initial financial outlay for the graphite furnace technique is about 35% greater. (Baker-FRC) W81-03823

NITROGEN CONTENTS OF STREAMS DRAINING AN AGRICULTURAL AND A FOR-ESTED WATERSHED IN CENTRAL ITALY,

Pisa Univ. (Italy). Inst. di Agronomia. F. Caporali, P. Nannipieri, and F. Pedrazzini. Journal Environmental Quality, Vol 10, No 1, p 72-80, January/March, 1981. 2 Fig, 2 Tab, 11 Ref.

Descriptors: \*Nitrogen, \*Land use, \*Italy, \*Streams, Watershed management, Watersheds, Groundwater basins, Forest watersheds, Agricultural watersheds, Drainage area, Land management, \*Agricultural runoff.

This survey was conducted to more fully understand the effect of agriculture on the N status of streams in central Italy and to better define the

relation between land use and water quality. Two watersheds were explored. The Era watershed is hilly, wooded, and cropped to winter cereals, rotated forages, vineyards and olive groves. Fertilizer applications amount to 100 kg N/ha and 150 kg N/ha. The Reno watershed is mountainous and is located in the Central North Appennine chain. Forests contain mainly chestnut and beech. Most of the N losses from the agricultural and forested watersheds, occurred during, late, autumn and of the N losses from the agricultural and forested watersheds occurred during late autumn and winter, and were more dependent on total flow than on nutrient concentration and land use. Monthly fluctuations in the concentrations of NO3-N from the Era watershed may represent an interaction of organic matter mineralization and N fertilization at the time seeding takes place. Agricultural land use thus influences the content of the most highly oxidized form of N in the surface waters. It is suggested that the overall contribution to surface water eutrophication is negligible, and to surface water eutrophication is negligible, and that nutrients find their way into watercourses from sources other than agricultural ones. (Baker-FRC) W81-03830

OCCURRENCE OF VIBRIO CHOLERAE SER-OTYPE O1 IN MARYLAND AND LOUISIANA ESTUARIES,

Maryland Univ., College Park. Dept. of Microbi-

ology. R. R. Colwell, R. J. Seidler, J. Kaper, S. W. Joseph, and S. Garges. Applied and Environmental Microbiology, Vol 41, No 2, p 555-558, February, 1981. 2 Tab, 20 Ref.

Descriptors: \*Cholera, \*Bacteria, \*Estuaries, Coasts, Vibrio cholerae, Chesapeake Bay, Louisi-ana, Salt marshes, Saline water, Aquatic life, Crus-taceans, Pollutant identification, Water analysis.

Vibrio cholerae O1, serotype Inaba, was isolated from water samples collected in Chesapeake Bay, and several Vibrio cholerae O1 and non-O1 strains and several Vibrio Cholerae OI and non-OI strains were found in water samples from Louisiana salt marshes and sewers during 1977-1980. The presence of these organisms in waters relatively free of fecal contamination suggests that they are a component of the autochthonous flora of brackish waters, estuaries, and salt marshes in the temperate waters, estuaries, and sait marines in the temperate zone coastal areas. Most of the strains were capable of digesting chitin and appeared to be associated with the macro- and microflora and fauna. The toxins of both O1 and non-O1 Vibrio cholerae may play a role in salt tolerance and osmoregulation in crustacea. (Cassar-FRC) W81-03848

PARTITIONING OF HEAVY METALS INTO MINERAL AND ORGANIC FRACTIONS IN A SEDIMENT CORE FROM TOKYO BAY,

SEDIMENT CURE FROM 10AYO BAT, Nagoya Univ. (Japan). Water Research Inst. Y. Kitano, M. Sakata, and E. Matsumoto. Geochimica et Cosmochimica Acta, Vol 44, No 9, p 1279-1285, 1980. 3 Fig. 2 Tab, 28 Ref.

Descriptors: \*Heavy metals, \*Sediments, \*Tokyo Bay, Japan, Copper, Zinc, Iron, Manganese, Chemical composition, Sulfides, Silicates, Carbonates, Sampling, Cores, Atomic absorption spectrophotometry.

The partitioning of copper, zinc, iron and manga-nese in Tokyo Bay sediment core samples dated by the Pb-210 method is described. Heavy metal con-centrations were determined by atomic absorption spectrophotometry. The pyrite-sulfur and organic carbon contents of the sediment increased steadily carbon contents of the sediment increased steadily toward the surface of the core. Except for pyrites the mineral composition of the sediments is not significantly changed with depth in the core. X-ray diffraction patterns showed peaks due to quartz, feldspar, kaolinite and illite. Calcitic calcium carbonate was identified in the lower layer of the core. A sedimentation rate of 0.13 g/square centimeter/yr was established. Copper and zinc in the HF soluble fraction were relatively constant, independent of depth in the sediment core. Copper and zinc decreased with depth. The vertical distribution of manganese in the sediment core was greatly different from that of the other heavy metals. The manganese content of the HF soluble fraction was

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5A-Identification Of Pollutants

nearly constant against depth. In the HCl soluble fraction its content is low in the upper layer. In the H202 soluble fraction the manganese content in-creased toward the surface of sediments. (Baker-

HYDROCARBONS IN AGE-DATED SEDI-MENT CORES FROM TWO BASINS IN THE SOUTHERN CALIFORNIA BIGHT, California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics. For primary bibliographic entry see Field 5B. W81-03859

WHOLE ORGANISM 31P NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY: A POTENTIAL APPLICATION IN AQUATIC TOXICTY EVALUATIONS,
Texas Univ. at Dallas, Richardson.

W. T. Waller, and A. D. Sherry.

Bulletin of Environmental Contamination and
Toxicology, Vol 26, No 1, p 73-76, 1981. 2 Fig. 5

Descriptors: \*Midges, \*Bioindicators, \*Phosphorus, Biomass, Pollutant identification, Indicators, Monitoring, \*Spectroscopy, Toxicity.

The usefulness of P-31 nuclear magnetic resonance spectroscopy (NMR) to obtain well-defined phosphorus spectra from Chironomus tentans larvae and Daphnia magna was investigated. The ability to monitor mobile phosphorus may prove useful in evaluating the effects of toxicants on aquatic organisms. The spectra obtained clearly demonstrate that satisfactory signal to noise ratios can be obtained using the methodology and species reported. The method allows rapid and nondestructive quantification of each of the phosphorus containing metabolites reported. A higher signal to noise ratio was obtained using the chironomid larvae when compared to D. magna, probably resulting from a higher biomass of chironomids in the NMR tube and a better distribution of larvae within the The usefulness of P-31 nuclear magnetic resonance tube and a better distribution of larvae within the rf coil. Research is now needed to determine how sensitive the mobile phosphorus components are to low concentrations of toxicants. (Baker-FRC)

HYDROCARBONS OF AQUATIC AND TER-RESTRIAL ORIGIN IN MOUNTAIN STREAMS OF THE MARMOT BASIN, Calgary Univ. (Alberta). Kananaskis Center for Environmental Research.

Journal of Environmental Quality, Vol 10, No 1, p 103-107, January-March, 1981. 3 Fig, 1 Tab, 31

Descriptors: \*Marmot Basin, \*Hydrocarbons, \*Streams, \*Mountains, Alkanes, Soil, Sedimentation, Sediments, Basins, Drainage area, Water-sheds, Catchment areas, Alpine regions, \*Alberta, Canada.

The Marmot Creek drainage basin was used to study the presence of organic compounds in mounstady the presence of organic compounds in mountain streams. The drainage basin is located in the Kananaskis range of the eastern Rocky Mountains, Alberta, Canada. The basin consists of three subbasins, each containing a major stream, joining to form a single larger stream, the Main Marmot, draining into the Kananaskis River. Vegetation in the area is dominated by spruce-subalpine fir forests. Soil types include brunisolic grey wooded, podzolic, regosolic, local greysolic, and organic. Samples from the Marmot basin contained 0.02-0.06 microgram/liter of n-alkanes. The predominant hydrocarbons were between C-13 and C-31, being in decreasing order C-27, C-25, C-21, C-20, C-19, C-29, and C-17. It was suspected that a large part of the hydrocarbons present arose from aquatto organisms. The presence of aromatic hydrocar-bons was not detected by gas chromatography at the detection limit of 1 ng/liter. Thus the source of the hydrocarbons appeared to include free-floating nonphotosynthetic microorganisms, soil, sediment and terrestrial vegetation. (Baker-FRC) W81-03898

MEASUREMENTS: THE KEY TO LABORA-

MEASUREMENTS: THE ALL TO LABORATORY ANALYSIS, D. W. Clark.
Water/Engineering and Management, Vol 128, No 1, p 63, 64, 66, January, 1981. 2 Fig, 1 Tab.

Descriptors: \*Water quality control, \*Measuring instruments, Analytical techniques, Colorimetry, Titrimetry, Spectrophotometry, Photometry, Quantitative analysis.

Without a thorough understanding of the tools of measurement, what each is capable of doing, and the type of results one will obtain from using a specific measuring tool, analytical procedures will not produce as precise results as possible. Measurements can be qualitative, simply determining whether a specific substance is present in the sample, or quantitative, determining the concentra-tion of the substance in the sample. Errors can arise that will have little effect on the outcome, or, arise that will have little effect on the outcome, or, due to inadequacy of analyst or equipment, can alter the outcome significantly. In testing water quality, titrimetric determinations are commonly employed. For a reaction to be suitable for titrimetric procedures it must be both stoichiometric and tric procedures it must be both stoichiometric and rapid, and have a reproducible end point that coincides with the stoichiometric point of the reaction or has a fixed relationship to it. Colorimetry-spectrometry can be used in cases where the intensity of a color formed by chemical reaction can be equated with the concentration of the substance to determined. Use of ion-selective electrodes in analytical measurements is also discussed. (Baker-FRĆ) W81-03899

DIFFERENTIAL INACTIVATION OF THREE BACTERIOPHAGES BY ACID AND ALKALINE PH USED IN THE MEMBRANE ADSORPTION-ELUTION METHOD OF VIRUS RECOVERY

RECOVERY, Ohio Univ., Athens. Dept. of Zoology. C. M. Sabatino, and S. Maier. Canadian Journal of Microbiology, Vol 26, No 12, p 1403-1407, December, 1980. 3 Tab, 24 Ref.

Descriptors: \*Hydrogen ion concentration, \*Analytical techniques, \*Viruses, Bacteriophage, Adsorption, Microorganisms, Water analysis.

Two coliphages, WPK and T4 and F116 of Pseudomonas aeruginosa, were tested for their resistance to acid and alkaline exposures. T4 alone proved to be acid resistant, allowing for acid adsorption, and WPK was sufficiently alkali resistant to allow for alkaline elution. The differential susceptibility of various phages thus makes it impossi-ble to use the acid membrane adsorption-alkaline elution method as a general method for concentrating phages from large volumes of water. (Baker-FRC)
W81-03902

WASTEWATER CHEMICAL AFFECTS PLANT

GROWTH, Arizona Univ., Tucson. Coll. of Agriculture. F. R. Katterman, and A. D. Day. Water and Wastes Engineering, Vol 17, No 8, p 33-35, August, 1980. 2 Fig, 6 Ref.

Descriptors: \*Plant growth regulators, \*Municipal wastewaters, Organic compounds, Cytokinins, Kinetin, Water pollution effects, Pollutant identification, Effluent, Control.

A cytokinin-like factor in municipal waste water effluent was isolated, purified, and characterized. Ultraviolet spectral properties of the unknown ma-terial were similar to those of a class of natural synthetic compounds known as ureido adenosines, associated with the ureido adenosine chromoassociated with the treaton authorsine Chrolino-phore. This material, previously observed to exhibi-it plant growth regulator properties, was compared with kinetin (6-furfurylamino pyridine) in wheat chlorophyll retention bioassay tests. Cytokinin ac-tivity increased rapidly in kinetin from 0 to 0.3 mg per liter and then leveled off. The ureido adenosine chromophore did not significantly retard chloro-phyll degradation until a concentration of 0.3 mg per liter was reached. Activity leveled off and then

dropped off at 1.5 to 3.0 mg per liter and at all times was much less than that of the natural cytotimes was much less than that of the natural cytic-kinins. The waste water isolate ultraviolet spectra, which did not correspond to any synthesized ureido adenosine compounds known, may have been altered by degradation processes during sewage treatment. Further work is in progress to identify the compound's exact nature. (Cassar-

#### 5B. Sources Of Pollution

CURRENT STATUS OF COMBINED SEWER PROBLEMS AND THEIR CONTROL MEASURES IN JAPAN,

URES IN JAPAN,
Public Works Research Inst., Tokyo (Japan).
Water Quality Control Div.
M. Kuribayashi, and E. Nakamura.
In: Proceedings; Seventh United States/Japan
Conference on Sewage Treatment Technology,
May 19-21, 1980, Tokyo, Japan. Environmental
Protection Agency Report EPA-60/9-80-047, December, 1980, p 263-310. 27 Fig, 8 Tab.

Descriptors: \*Combined sewer overflows, \*Urban runoff, \*Storm runoff, \*Sewer systems, Water pol-lution control, Separated sewers, Pollution load, Water quality standards, Mathematical models, Water pollution prevention, \*Japan.

Combined sewers now serve 37% of the population of Japan, and ultimately it is projected that 53% of the population will be served by them, with the remaining population served by separate systems. A survey was conducted for three years at 16 experimental districts throughout Japan to determine the discharged pollutant load, and its contribution to the total load, under wet weather conditions. In terms of average water quality, the combined sewer systems fail to meet effluent standards only for suspended solids, and storm runoff water quality from separate systems is no better than the combined sewer wet weather flow. Mathematical models have been developed to investimation. than the combined sewer wet weather flow. Math-ematical models have been developed to investi-gate stormwater runoff and wet weather loads. Measures taken against combined sewer problems include: improvement of intercepting systems by raising the weir height, increasing the interceptor raising the wei neight, increasing the interceptors on-site or off-site storage, and overflow sedimentation basins; and experimental measures which include swirl regulator/concentrators, sewer flushing, and catch basins. (Brambley-SRC) W81-03616

CURRENT RESEARCH ON LAND DISPOSAL OF MUNICIPAL SOLID WASTES,

Environmental Protection Agency, Cincinnati, For primary bibliographic entry see Field 5E. W81-03630

LEACHATE PRODUCTION AND MANAGE-MENT FROM MUNICIPAL LANDFILLS: SUM-MARY AND ASSESSMENT, Calscience Research, Inc., Huntington Beach, CA.

Calscience Research, Inc., Huntington Beach, CA. J. C. S. Lu, R. D. Morrison, and R. J. Stearns. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: Al 2 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, Pennsylvania. Shultz, D. W., Ed., EPA Report EPA-600/981-002a, March, 1981, p 1-17. 10 Fig, 6 Tab, 23 Pef

Descriptors: \*Landfills, \*Leachates, \*Municipal wastes, \*Waste disposal, Soil properties, Waste characteristics, Models, Percolation, Groundwater contamination, Pollutants, Water pollution control, Water pollution prevention, Monitoring.

This report is a review, analysis, and evaluation of current literature and information on municipal landfill leachates with the overall objective of pro-viding documentation of practical information, current techniques, comparative costs, and addi-

Sources Of Pollution—Group 5B

tional research needs on the generation, composi-tion, migration, control and monitoring of lea-chates. Leachate generation is determined by the availability of water, the landfill surface condiavailability of water, the landfill surface condi-tions, the refuse conditions, and the characteristics of the underlying soil. Leachate composition is extremely variable, but has been determined to be affected by the waste itself, landfill location, cli-mate, site engineering factors, and the age of the landfill. No leachate model exists that can simulate all of the physical, chemical, and biological proc-esses involved in leachate migration, but migration is affected by soil properties, migration mecha-nisms, and the migration trends of contaminants. Leachate control technologies can be classified into four types: volume control; composition con-trol; collection; and treatment and ultimate dispos-al. Leachates in the zone of aeration and zone of al. Leachates in the zone of aeration and zone of saturation must be monitored, and the sample areas, monitoring frequency and parameters, and sample collection and preservation should be considered. (Brambley-SRC) W81-03631

LEACHATE PRODUCTION BY LANDFILLED PROCESSED MUNICIPAL WASTES, Systems Technology Corp., Xenia, OH. J. M. Kemper, and R. B. Smith. Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: A12 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Pro-ceedings of the Seventh Annual Research Sympo-sium, March 16-18, 1981, Philadelphia, Pennsylva-nia, Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 18-36. 10 Fig, 3 Tab, 6

Descriptors: \*Leachates, \*Municipal wastes, \*Waste disposal, \*Lysimeters, Pollutants, Chemical composition, Solid waste disposal, Gas forma-

The purpose of the project was to evaluate waste processing methods used prior to landfilling solid wastes by comparing the leachates produced by wastes that were processed in different ways. Five lysimeters (buried concrete landfill simulators) lysinitetes (our control control solid wastes that were shredded and baled, baled, baled and saturated with water, shredded, and unprocessed, respectively. Leachate samples were collected to determine moisture balances and leachate pollutant concentrations in order to evaluate the processing methods. After equal volumes of water were applied to all five lysimeters, the baled wastes were found to produce large quantities of dilute leachate, while the shredded waste produced smaller quantities of concentrated leachate. Gas composition data from the lysimeters was inconsistent but did not indicate any obvious differences among the waste processing methods. (Author's abstract)
W81-03632

#### RECOVERY OF FECAL-INDICATOR AND PATHOGENIC MICROBES FROM LANDFILL LEACHATE, Cincinnati Univ., OH.

Cincinnati Univ., Ori.

J. A. Donnelly, P. V. Scarpino, and D. Brunner.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173874, Service, Springieid, VA 22101 as Pabi-1788/4, Price codes: Al2 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Pro-ceedings of the Seventh Annual Research Sympo-sium, March 16-18, 1981, Philadelphia, PA. Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 37-54. 1 Fig. 9 Tab, 27 Ref.

Descriptors: \*Landfills, \*Leachates, \*Bacteria, \*Pathogens, Solid wastes, Lysimeters, Municipal wastes, Feces, Microorganisms, Wastewater, Survival, Groundwater contamination, Public health, Sludge, Coliforms, Streptococcus, Sewage bacteriae

Leachates from commercial and large scale experimental landfills and laboratory lysimeters containing various solid wastes were studied. Microbial assays on active landfuis demonstrated that the leachate contained high concentrations of Gramnegative rods, some of which were identified as

Enterobacter aerogenes, Citrobacter sp., Salmonel-la sp., Serratia marcescens, Proteus sp. and Aero-monas sp. The Gram-positive bacteria present monas sp. The Gram-positive bacteria present were Clostridium perfringens, Streptococcus facalis, S. faccium, S. viridans, and Mycobacterium sp. All of these bacteria may be present in human feces, and several are pathogenic for humans. Landfills inactive for 2 to 6 years had very low concentrations of Gram-negative rods. The most abundant microorganisms present were Streptococcus faecalis, Corynebacterium sp., Bacillus sp., yeasts and molds. Pathogens found in these old landfills were Listeria monocytogenes, Acinetobacter sp., Moraxella sp., and Allescheria boydii. Newly constructed laboratory lysimeters containing a variety of municipal wastes, demonstrated ing a variety of municipal wastes, demonstrated very low coliform levels in the leachate after 4 very low collorm levels in the leachate after 4 months. The streptococcal levels remained higher, but eventually dropped below the detection level after 1 1/2years. However, the laboratory lysimeters containing sewage sludge continued to discharge fecal microorganisms, both colliform and streptococci, even after two years. Fecal-indicator bacteria were isolated in the solid waste from lysimeters 2 years old, and from a 9 year old fullscale landfill. These results demonstrate that do not die as rapidly in landfills as previously reported but survive for extended periods of time with potential to contaminate ground and surface water when released in leachates from the landfills. nd and surface (Brambley-SRC) W81-03633

#### LEACHATE AND GAS FROM MUNICIPAL SOLID WASTE LANDFILL SIMULATORS, SCS Engineers, Covington, KY.

J. J. Walsh, R. N. Kinman, and J. I. Rickabaugh. Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: A12 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proin: Land Disposai: Multi-pa Solid waste, rio-ceedings of the Seventh Annual Research Sympo-sium, March 16-18, 1981, Philadelphia, Pennsylva-nia. Shultz, D. W., Ed., EPA Report EPA-600/9, 81-002a, March, 1981, p 67-93.

Descriptors: \*Landfills, \*Simulation, \*Leachates, \*Lysimeters, \*Municipal wastes, Infiltration, Field capacity, Chemical composition, Temperature, Aerobic conditions, Anaerobic conditions, Cas foration, Sludge, Industrial wastes.

The objective of the program was to determine the impact of solid waste decomposition from varying moisture infiltration rates, adding pH buffering moisture infiltration rates, adding pH bultering compounds, prewetting the wastes, varying ambient temperatures, and codisposing refuse with sewage sludge and various industrial wastes. To this end, a total of 19 landfill simulators were constructed in late 1974 and early 1975. Each was loaded with approximately 3.0 metric tons of municipal refuse. Small quantities of sewage sludge, industrial wastes, or other materials were added to 12 of these simulators. Maintenance, operation, and monitoring of these landfill simulators was then begun and has continued to this date. Water addi-tions are made on all simulators on a prescribed schedule to simulate rainfall conditions in the Midwest U. S. Gas and leachate are collected, quantified, and analyzed. Refuse, soil, and ambient air temperatures are recorded. Field capacity for the municipal-solid-waste-only test cells was reached after 339-540 days with 400 mm/year infiltration rates, 150 days with 800 mm/year, and 480 days with 600 mm/year. The moisture retained at field capacity ranged from 1.02-1.31 1/kg except for one cell. With all infiltration rates, the leachate cumulative contents of TOC, COD, total Kjeldahl nitrogen, total solids and nickel were asymptotic, while cumulative iron content was linear. The cell temcumulative iron content was linear. The cell temperatures fluctuated considerably. For the first 1-1.5 years of observation carbon dioxide predominated, but was replaced by methane when anaerobic conditions were established. The total gas volume achieved ranged from 3-18 l/kg over 5.75 years. (Brambley-SRC)

COLLECTION OF REPRESENTATIVE WATER QUALITY DATA FROM MONITORING WELLS,
Illinois State Water Survey, Peoria.
For primary bibliographic entry see Field 7B.
W81-03636

CONTAINMENT OF HEAVY METALS IN LANDFILLS WITH LEACHATE RECYCLE, Georgia Inst. of Tech., Atlanta. School of Civil

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

F. G. Pohland, J. P. Gould, R. E. Ramsey, B. J. Spiller, and W. R. Esteves.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: A12 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, Pennsylvania. Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 179-194. 14 Fig. 2 Tab, 15 Pef.

Descriptors: \*Leachates, \*Heavy metals, \*Recycling, \*Landfills, \*Water pollution prevention, Chemical precipitation, Chemical reactions, Inorganic compounds, Organic compounds, Sulfides, Detoxification, Lysimeters, Industrial wastes, Do-

The presence, transport and ultimate fate of heavy metals in landfill leachate are discussed with repect to the opportunities for physical-chemical interaction within the landfill environment. Most leachates were found to contain high concentrations of dissolved ions and a broad array of organic and inorganic ligands such as sulfide, chloride, sulfate, phosphate, and armonia which, coupled with the anaerobic reducing conditions of the landfill, favored the removal of heavy metals primarily by precipitation as sulfides. This removal was enchanced by the increased stabilization rates and filtering action promoted by the recirculation of filtering action promoted by the recirculation of leachate through the landfill mass. These observaleachate through the landfill mass. These observations were fortified by data obtained from analysis
of leachate samples from four simulated landfill
lysimeters columns operated under conditions of
leachate collection and recycle and with codisposal of residential-type refuse and metal plating
sludge. Utilizing equilibrium concepts modified by
considerations for ionic strength and by activity
corrections, the potential for precipitation and/or
complexation of heavy metals and the profound
impact of sulfides on these reactions were determined. It may be possible for many landfills to
receive and detoxify certain types of industrial
wastes without causing irreversible damage to the
stabilization processes within the landfill or to the
surrounding environment. (Brambley-SRC)
W81-03640

SUMMARY OF LANDFILL RESEARCH; BOONE COUNTY FIELD SITE, Regional Services Corp., Inc., Columbus, IN. For primary bibliographic entry see Field 5G. W81-03641

SECTION 404(B) TESTING, Army Engineer Div. North Atlantic, New York. R. Pierce.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 3. 14 p. 5 Fig.

Descriptors: \*Dredging, \*Testing procedures, \*Pollution prevention, \*Site selection, \*Spoil dis-posal, Water pollution, Standards, Pollutant identi-fication, Spoil banks, Ocean dumping, Benthic en-

Section 404(b) (1) of the Clean Water Act of 1977 directs the Administrator of EPA in Conjuction with the Secretary of the Army to develop guidelines governing the specification of sites for the discharge of dredged and fill material. A testing discharge of uteget and in inactial. A testing package was developed to give clear and unequivocal guidance on the appropriate test or tests needed to characterize the material to be discharged; which test to start with; under which

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#### Group 5B-Sources Of Pollution

situations additional tests are necessary; and when enough tests had been run. Discharges are catego-rized by the type of operation and the level of contamination in the dredged material and at the discharge site. The heart of this scheme is the precategorization evaluation. It is the first step in the process and is the mechanism by which the discharge is placed into the proper category. During this evaluation the contaminants of concern that may be present in the dredged material are identified. The five categories for dredged material are: discharge without potential for environ-mental contamination; open water discharge with level of contamination; open water discharge with level of contamination similar to the discharge site; contained or confined discharges; open water discharges with potential for harm to the benthic environment; and discharges with potential for harm in the water column. (Moore-SRC) W81-03642

DREDGED MATERIAL DISPOSAL CASE STUDY; MILITARY OCEAN TERMINAL, SUNNY POINT, NORTH CAROLINA, Army Engineer District, Wilmington, NC. C. C. Meshaw.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 20. 7 p, 3 Fig.

Descriptors: \*Dredging, \*Waste disposal, \*Saline water intrusion, \*Sinks, \*Land disposal, Ground water, Water pollution, Ponds, Encroachment, En-vironmental effects, Wildlife.

The Military Ocean Terminal is located on the Cape Fear River about 6 mi upstream of Southport, North Carolina. Shoaling of the access channels and basins has averaged 1.8 million cu yd annually. and dredging has generally been needed on a biannual basis. When open water disposal of dredged material was discontinued, two diked upland disposal areas having a compined canacity. upland disposal areas having a combined capacity of 28.5 million cu yd of dredged material were built. In 1977, high chloride concentrations, 100 ppm and up, were reported in several monitoring wells near the disposal area in use. Since the disposal area was constructed in an area of numerous limestone sinks, saltwater intrusion was considered to be the source of the chloride. To determine the extent of saltwater intrusion and to monitor its movement, 58 wells were drilled in and around the movement, 36 wells were drilled in and around the disposal area. These wells, together with about 54 surface water sampling locations are sampled on a monthly basis. By September 1977, saltwater had moved out from and far beyond the boundaries of the disposal area. Of particular importance is the spread of the saltwater plume into nearby ponds. There is concern for the long term effects of the saltwater intrusion on potential water supply, and saltwater intrusion on potential water supply, and endangered species. (Moore-SRC) W81-03656

INTRODUCED CHEMICALS AND WATER QUALITY,
Pacific Northwest Forest and Range Experiment
Station, Corvallis, OR.

L. A. Norris, and D. G. Moore.

L. A. NOITIS, and D. U. MOOTE. In: Proceedings of Interior West Watershed Man-agement Symposium, April 8-10, 1980, Baum-gartner, D.M., Ed., Washington State University, Pullman, 1981, p 203-220. 8 Fig. 11 Tab, 28 Ref.

Descriptors: \*Water pollution sources, \*Pesticides, \*Fertilizers, \*Fire retardants, Forest management, \*Forest watersheds, Nitrates, Stream pollution, In-secticides, Herbicides, Fungicides, Leaching, Ureas, Water pollution prevention.

Forest managers use a number of chemicals to protect and enhance forest resource values. A variety of specific compounds are included within the general categories of pesticides, fertilizers, and fire retardants. Use of any of these chemical tools may result in their entry to aquatic systems. Forestry accounts for slightly more than 1% of the total pesticides used in the United States. Fertilizers are applied annually to only a small portion of com-mercial forest land. There has been a steady growth in the use of fire retardants. Direct application or drift to surface water or ephemeral stream channels is the principal mechanism by which aeri-ally applied chemicals enter forest streams. With the exception of nitrate nitrogen as a transforma-tion product of urea fertilizer or ammonia-based fertilizers or fire retardants, the long-term entry of chemicals via leaching to streams does not seem to occur at measurable levels. The concentrations and persistence of chemicals found in these streams persistence of chemicals found in these streams does not appear to represent a substantive hazard to aquatic organisms or downstream water users. Forest managers and chemical applicators can markedly influence the amount of chemical which enters streams by careful attention to the orienta-tion of treated areas to streams and the conditions of application. (Moore-SRC) W81-03662

OIL-WATER INTERFACIAL DETECTOR, For primary bibliographic entry see Field 5A. W81-03686

FLOW-THROUGH COALESCING SEPARA-

Marine Construction and Design Co., Seattle, WA. For primary bibliographic entry see Field 5D. W81-03688

MOVEMENT OF WATER AND NITRATE IN THE UNSATURATED ZONE OF UPPER CHALK NEAR WINCHESTER, HANTS., ENG-LAND.

LAND, Institute of Hydrology, Wallingford (England). S. R. Wellings, and J. P. Bell. Journal of Hydrology, Vol 48, No 1/2, p 119-136, August, 1980. 11 Fig. 1 Tab, 37 Ref.

Descriptors: \*Nitrates, \*Soil water movement, \*Unsaturated flow, \*Path of pollutants, Water pollution sources, Fertilizers, Agriculture, Hydrology, Nitrogen compounds, Chalk, \*England, Aquifers, Groundwater, Water table, Evapotranspiration.

An investigation of water and nitrate fluxes in the Chalk, south and east England's major aquifer, was conducted to clarify the physical processes in the unsaturated zone. Nitrates in water pumped from some sites in this important supply source exceed the 11.3 mg, per liter maximum limit for potable water, possibly as a result of increased fertilizer use. During field experiments, different rates of animal slurry and inorganic fertilizers were applied and fluxes measured in the upper 3 meters of the unsaturated zone under grass plots. Actual evapo unsaturated zone under grass piots. Actual evapor-ration from short crops was very close to potential evaporation as calculated by the Penman (1948) formula. Drainage of water to the water table occurs by unsaturated flow through the Chalk matrix during both summer and winter. A piston displacement model describes the observed distribution of solutes. The average annual rate of downward movement is about 0.9 meters per year, with a small lag of solute with respect to water. In summer upward water fluxes of 5-6 meters are capable of moving solutes back up the profile by 10 cm or more. Fissure flow of water and solutes is likely only after unusually heavy storms. Matrix flow appears to dominate over fissure flow at this site, implying that groundwater quality will deteriorate seriously in the future. However, other untested areas of the Chalk may behave differently. (Cassar-FRC) W81-03715

ANALYSIS OF THE TRANSIENT MOVEMENT OF WATER AND SOLUTES IN STREAM-AQUIFER SYSTEMS, California Univ., Davis. Dept. of Land, Air and

Water Resources. For primary bibliographic entry see Field 2F. W81-03717

NITROGEN CYCLING AND ASSIMILATIVE CAPACITY OF NITROGEN AND PHOSPHO-RUS BY RIVERINE WETLAND FORESTS, East Carolina Univ. Greenville, NC. Dept. of Biology. M. M. Brinson, H. D. Bradshaw, and E. S. Kane.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-218307, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Report No 167, June, 1981. 90 p, 25 Fig, 22 Tab. OWRT-B-114-NC(2), 14-34-0001-8107.

Descriptors: \*Wetlands, \*Cycling nutrients, Nutrients, Nutrients, Nutrient removal, Nitrogen, \*Phosphorus, Denitrification, Nitrate, Ammonium, Floodplains, Bottomland, Rooted aquatic plants, Roots, Tar Swamp, Creeping Swamp, North Carolina, Riverine swamps, Nitrogen cycling, Nutrient exchange.

Labeled (15N) nitrate and ammonium were added Lagered (15N) intrace and ammonian were added to swamp surface water and their diffusion to the forest floor was followed. Of the original nitrate added, 46% remained in the surface water of Tar Swamp and 62% in Creeping Swamp after 2 days. Two days after ammonium treatments corresponding levels were 79% and 81%. As indicated by the ing levels were 19% and 51%. As indicated by the absence of recoverable 151% in sediments following nitrate treatments, diffusion of labeled nitrate to the forest floor resulted in its transformation to N sub 2 O or N sub 2 by denitrification. Although labeled ammonium also diffused to sediments and accumulated in a sediment-exchangeable form, there was simultaneous efflux of unlabeled ammonium from sediments to the water column. Also, num from secuments to the water column. Also, ammonium was readily immobilized from the water by decomposing leaf litter and probably filamentous algae, both of which represent short term storages. However, exchangeable ammonium in the sediments was far more important in net accumulation. Available nitrogen reserves in the sediments were depleted through ammonification and nitrification during annual drydown episodes, and the capacity for additional nitrogen assimilation by the sediments was renewed. An experiment was then conducted to determine the capacity of sediments for sustained nutrient assimilation by adding nitrate, ammonium, phosphate, and second-arily treated sewage effluent to surface water in separate chambers at weekly intervals for 46 weeks. Nitrate disappeared rapidly from the surface water between weekly additions and did not accumulate in subsurface water. Phosphate added to surface water accumulated as an acid-extractable form in sediments to a level of nearly one-half of total sediment phosphorus by the end of the experiment. W81-03725

DETERMINING THE AVAILABILITY OF SEDIMENT-BOUND TRACE METALS AQUATIC DEPOSIT-FEEDING ANIMALS, Geological Survey, Menlo Park, CA. Water Resources Div.

Sources Div.

S. N. Luoma, D. J. Cain, E. Thomson, C.
Johannson, and E. A. Jenne.
Geological Survey Open-File Report 80-341,
March 1980. 333 p. 137 Ref.

Descriptors: \*Bottom sediments, \*Clams, \*Metals, Descriptors: "Bottom sediments, "Claims, "Metais, "Trace metals, "Estuarine environment, Physico-chemical properties, Benthos, Food chains, Ad-sorption, Copper, Zinc, Silver, Water pollution effects, California, "San Francisco Bay, Scrobicu-laria plana, Macoma Balthica, Nereis diversicolor, Fucus vesiculosus.

Physicochemical form affects, by as much as 1000 fold, the uptake rate by deposit-feeding clams of metals bound to sediments. The strength of metal binding to the different sedimentary binding subbinding to the different sedimentary binding substrates controls this effect. Statistical studies that were spatially intensive (comparing 35 stations in 17 estuaries) and temporally intensive (2 stations through 2 years time) indicate that sediments control the availability of Ag, Cd, Co, Pb, Zn, Fe, and Mn, and possibly Cu to clams and polychaete worms in nature. Metal concentrations removed from sediments by chemical extractants generally follow availability better than do total metal concentrations but the specific extractant different properties of the service of the statistical different properties of the service of the statistical different properties and the service of the servic tollow availability better than do total metal con-centrations, but the specific extractant differs among different metals. Concentrations of binding substrates (Fe, Mn, organic carbon, humic sub-stances) also statistically explain a proportion of the variance of metal concentrations in the animals, suggesting that metal partitioning among substrates in sediments is an important control on metal avail-

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ability. The specific substrates which contribute to availability also differ among metals. Statistical assessment of metal form in sediments suggested that different substrates compete for the partition-ing of metals, that each metal is partitioned among a variety of forms in an oxidized sediment, and that partitioning will vary with the physicochemical characteristics of the sediments. (USGS) W81-03728

CHARACTERIZATION OF AIR POLLUTANTS FROM AN ACTIVATED SLUDGE PROCESS,

P. A. Scheff, J. A. Holden, and R. A. Wadden. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 223-231, February, 1981. 8 Fig, 6

Descriptors: \*Air pollution, \*Wastewater facilities, \*Path of pollutants, Activated sludge, Coliforms, Bacteria, Monitoring, Trace elements, Heavy metals, Public health, Chicago, Waste water treat-

An 8 month monitoring program was conducted to determine environmental contamination from an activated studge plant in a Chicago suburb. Meas-urements were taken of air pollutants in the sururements were taken of air pollutants in the sur-rounding area of the plant out to 1.6 km. The air pollutants evaluated included total aerobic bacteria containing particulate, NO2, SO2, C12, NH3, H2S, NO3, SO4, and various trace elements. Grab sam-ples of waste water entering the aeration tanks taken concurrently with the air samples were ana-lyzed for the same pollutants. The mean plant levels of total viable bacteria (376 particles/cu m) and total coliform (6.9 coliform/cu m) were signifi-cantly greater than the 0.8 km upwind values for cantly greater than the 0.8 km upwind values for these parameters. The 0.8 km downwind values for total viable bacteria and total coliform were also significantly higher than their upwind counter-parts. Although results showed that the activated sludge plant was a souce of these bacterial pollutants no evidence was found to indicate that the facility was a major contributor of the other pollutants monitored. The health implications of these indings are discussed in relation to plant operation, design and planning. (Geiger-FRC)

W81-03757

POLLUTION POTENTIAL AND CORN YIELDS FROM SELECTED RATES AND TIMING OF LIQUID MANURE APPLICA-

Department of Agriculture, Ottawa (Ontario). Engineering and Statistical Research Inst.

P. A. Phillips, J. L. B. Culley, F. R. Hore, and N. K. Patni.

Transactions of the ASAE, Vol 24, No 1, p 139-144, January-February, 1981. 1 Fig, 5 Tab, 15 Ref.

Descriptors: \*Runoff, \*Manure, Water quality, Surface runoff, Surface water, Subsurface water, Storm seepage, Nitrogen, Phosphorus, Potassium, Nutrients, Corn, Crop production, Fertilizers.

The effects of rate and time of liquid manure application, chemical fertilizer application or no application of fertilizer were studied on the chemical composition of surface and subsurface water and on crop yield. Liquid manure was applied at three rates of 224, 560, and 897 kg N/ha/yr. Surface runoff concentrations of inorganic N, P and K from winter applied manure increased in proportion to increased application rates. They were also tion to increased application rates. They were also much higher than concentrations from spring, fall, spring-fall and chemical fertilizer treatments. Most of the nitrogen and phosphorus in surface runoff during June storms was associated with suspended sediment that resulted from erosion. Neither the amounts of sediment nor their N and P contents amounts of sediment nor their N and P contents were affected by manure or fertilizer applications. It was concluded that the winter application of manure at any rate on areas that contribute runoff directly to bodies of surface water is not to be artectly to be recommended. Non-winter applications of manure at or above rates of 560 kg N/ha/yr may also lead to water quality impairment. (Baker-FRC) W81-03766

EXPERIENCES WITH RUNOFF CONTROL SYSTEMS IN INDIANA,
Purdue Univ., Lafayette, IN. Dept. of Agricultural

Engineering.
J. C. Nye, and D. D. Jones.
Transactions of the ASAE, Vol 23, No 6, p 1409-1412, November/December, 1980. 2 Tab. 14 Ref.

Descriptors: \*Infiltration, \*Settling basins, \*Feedlot runoff, \*Feedlot wastes, Livestock wastes, Feedlots, Runoff, Ultimate disposal, Design storm, Slopes, Farm wastes, Waste disposal, Indiana.

The state-of-the-art of livestock facilities' runoff control systems in Indiana is presented. Settling basins combined with vegetative infiltration areas are in common use in the state. After heavy solids have separated from liquids in the basins, the effluent is pumped or allowed to run into the infiltration area to soak into the soil and filter through the grass. Field observations of these systems led to grass. Field observations of these systems left to several design recommendations. The design storm should be 1 year-1 hour (3 cm); surface settling rate, 1.2 cu meters per hour per sq meter; length to width ratio, 4 to 1; sludge storage depth, 0.3 meters depending on the operation; and weir overflow rate, 24-27 cu meters per hour-meter. A dewater-ing type basin outlet is best constructed with a ing type basin outlet is best constructed with a perforated riser with expanded metal. The liquid type basin outlet, often flat concrete, is improved with a baffle to prevent overflow of floating solids. Solids should be removed after each major storm. Solids should be removed atter each major storm. Baffles in the inlet promote even distribution of influent. The liquid basin floor should slope at 6% to the sludge removal point, and the dewatering basin floor should gradually slope at 1% toward the outlet. In designing vegetative infiltration areas, criteria to consider are infiltration rate and water holding capacity of the soil, travel time during an extreme storm, and a maximum of 400 kg N per hectare per year nutrient loading. (Cassar-FRC) W81-03771

DYNAMICS OF RURAL NONPOINT SOURCE WATER QUALITY IN A SOUTHEASTERN WATERSHED,

North Carolina State Univ., at Raleigh. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2A.

MOMENT METHODS FOR ANALYZING RIVER MODELS WITH APPLICATION TO POINT SOURCE PHOSPHORUS, West Virginia Univ., Morgantown. Dept. of Chemical Engineering. For primary bibliographic entry see Field 5A. W31-03786

LAGGED CORRELATION IN STUDY OF SPA-TIAL PATTERN OF WELLS CONTAMINA-TION,

Texas Univ. Health Science Center at Houston. H. H. Birden, and I. Cech. Water Research, Vol 15, No 3, p 291-299, 1981. 8 Fig. 10 Ref.

Descriptors: \*Wells, \*Spatial distribution, \*Bacteria, \*Path of pollutants, Contamination, South Windsor, Connecticut, Coliforms, Nitrate.

Results of a sanitary survey of drinking water wells conducted since 1977 in South Windsor, Connecticut are presented. The aquifer from which water in the area was drawn is composed of sandstone layers of varying permeability alternated with layers of shale. The aquifer is non-artesian, but is confined to some extent by an overlying glacial till hardpan of low permeability. The analysis showed that nitrate levels throughout the area were randomly distributed with no persistent relation to any particular spatial point and no correla-tion with coliform bacteria. One exception oc-curred in the immediate vicinity of one residence, where direct contamination of drinking water by sewage had occurred. The nitrate concentration reflected what was naturally occurring in this aquifer for all other tested wells. Bacterial levels showed strong spatial correlations from one well

to another. A channeled flow of bacterial contamination through the area was noted with very little lateral dispersion from a northeast-northwest-south line. This contamination was entering the aquifer nne. Ins contamination was entering ine aquiter from a single place and was then propagated through a lens of higher permeability or a frac-tured system. The adaptation of the Blackman-Tukey methodology of time series analysis was most useful in this particular study. (Baker-FRC) W81-03787

ASBESTOS-CEMENT MATERIALS USED IN WATER SUPPLY, Health Effects Research Lab., Cincinnati, OH.

Tream Electr Research Lab., Cincinnati, OH. J. R. Millette, M. F. Pansing, and R. L. Boone. Water/Engineering and Management, Vol 128, No 3, p 48, 51, 60, 97, March, 1981. 2 Fig, 4 Tab, 25 Ref.

Descriptors: \*Asbestos, \*Pipes, \*Water distribution(Applied), Risks, Public health, Water conveyance, Water pollution effects, Asbestos cement, Toxicity, Water quality, \*Water pollution

An assessment of current information on the ques-tion of health risks of asbestos fibers, a human carcinogen, in drinking water supplies is presented. Asbestos fibers are found in drinking water sup-plies where asbestos cement (A/C) pipe used in the distribution supplies. plies where asbestos cement (A/C) pipe used in the distribution system is degraded by corrosive water. It has been estimated that 16.5% of the 200,000 miles of A/C pipe in the U.S. is exposed to highly aggressive water and 52% to moderately aggressive water. This amounts to a possible exposure of 40 million persons. On the other hand, one study showed that 45 out of 46 towns having aggressive water and A/C pipe had no high fiber levels or deteriorated pipe. Current studies indicate that asbestos fibers can penetrate the gut wall. However, there is no conclusive laboratory or epidemiologic there is no conclusive laboratory or epidemiologic unere is no conclusive laboratory or epidemiologic evidence that ingested asbestos causes gastrointestinal cancer. Although there is not enough evidence to support a drinking water standard for asbestos, A/C materials should not be used in new construction in corrosive water areas. Where A/C pipe is deteriorating, efforts should be made to treat the water and/or coat the pipe. (Cassar-FRC) W81-03789

BIODEGRADATION OF PENTACHLORO-PHENOL IN A SIMULATED AQUATIC ENVI-RONMENT,

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
D. Liu, K. Thomson, and W. M. J. Strachan. Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 85-90, 1981. 2 Fig. 1 Tab, 18 Ref.

Descriptors: \*Biodegradation, PCP, \*Pesticide ki-netics, Microbial degradation, Activated sludge, Anaerobic conditions, Fermentation, Aerobic con-ditions, Pesticides, Chlorinated hydrocarbons, Me-tabolism, Fate of pollutants, Organic nitrogen, Simulation analysis, \*Pentachlorophenol.

The rate of sodium pentachlorophenate (NaPCP) biodegradation was examined under aerobic/anaerobic conditions, with/without co-metabolites, and with different nitrogen sources in laboratory cy-clone fermenters employing an acclimatized bacte-rial culture from activated sludge. NaPCP biodegradation was measured as the disappearance of the compound from the fermenter broth after cor-rection for NaPCP loss due to abiotic factors. Rate rection for NaPCP loss due to ablotic factors. Rate constants were determined by first-order kinetics, and half-lives were calculated as functions of a rate constant expression. After three days, the NaPCP in the aerobic fermenter had decreased to a negligible amount (half-life 0.36 day), while 100% of the added NaPCP remained unchanged in the anaerobic fermenter (half-life 192 days). Both glucose and fermenter (half-life 192 days). Both glucose and monochlorophenol suppressed the rate of NaPCP biodegradation. Yeast extract as nitrogen source showed a distinct stimulatory effect on NaPCP degradation, while peptone tended to inhibit NaPCP biodegradation. Since NaPCP is often detected in many aquatic environments, the present test system is offered as a simulation tool for investigating the complex interactions between this pes

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ticide and different environmental parameters to discern degradation mechanisms. (Geiger-FRC) W81-03806

LEVELS OF HYDROCARBONS IN MUSSELS, MYTILUS EDULIS, AND SURFACE SEDI-MENTS FROM DANISH COASTAL AREAS, Marine Pollution Lab., Charlottenlund (Denmark). For primary bibliographic entry see Field 5A. W81\_03812

PROFILE MEASUREMENTS OF PARTICLE MASS TRANSFER AT THE AIR-WATER IN-TERFACE,

Governors State Univ., Park Forest South, IL Coll. of Environmental and Applied Science.

Atmospheric Environment, Vol 15, No 2, p 123-129, 1981. 2 Fig, 1 Tab, 23 Ref.

Descriptors: \*Air-water interfaces, \*Water pollu-tion sources, Lakes, \*Lake Michigan, Wind veloc-ity, Interfaces, Water pollution, Particulate matter, Air pollution, Mass transfer, Momentum transfer.

In the context of a study to determine trace ele-ment loading to Lake Michigan, a limited profile ment loading to Lake Michigan, a limited profile method was used to estimate particle deposition velocity as a function of size for particles of a diameter between 0.1 and 2.0 millimicrons. Mete-orological and aerosol measurements were taken at two sampling sites on Lake Michigan. The limited profile method data suggest that the surface resistance for particle mass transfer at the air-water interface may be small. No strong dependence of particle mass transfer upon particle size in the accumulation mode was found. In only one case accumulation mode was found. In only one case did a profile data set suggest more than a two-fold difference in particle deposition velocity across the diameter range investigated. The overall mean ratio of particle deposition velocity to momentum transfer velocity for a total of 20 moderate wind speed data sets is 0.28. This rather large ratio was not in agreement with expectations. One explanation for this is that fluctuating wind speed and direction may cause the water's roughness elements to protrude through the viscous sublayer, with the resultant surface resistance to particle ments to protrude through the viscous sublayer, with the resultant surface resistance to particle transfer substantially reduced. These limited profile measurements suggest fairly large transfer rates of atmospheric particles to open water bodies. (Carroll-FRC) W81-03821

THE RELEASE OF ARSENIC FROM CONTAMINATED SEDIMENTS AND MUDS, Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science. W. H. Clement, and S. D. Faust.

Journal of Environmental Science and Health, Vol A16, No 1, p 87-122, 1981. 5 Fig. 8 Tab. 32 Ref.

Descriptors: \*Arsenic, \*Water pollution sources, Arsenic compounds, Sediments, Muds, \*Bottom sediments, Wastewater pollution, Absorption.

The release of arsenic to overlying waters from stream muds and sediments was investigated under laboratory conditions. Muds were synthesized with arsenic concentrations similar to those encountered near industrial outfalls. Both anaerobic conditions and aerobic conditions were used in the study, and aeroole continons were used in the study, with dissolved oxygen levels of 100, 50, 25, and 10% saturation. In both aerobic and anaerobic systems, the lower the temperature, the smaller the distribution coefficient. At a given temperature very little difference was noted in the distribution coefficients at different saturation levels. Levels of arsenic, primarily as As(2+), were about 10 times higher under anaerobic than aerobic conditions. nigner under anaerobic tana aerobic conditions. The arsenic in aerobic reservoirs was about 70% arsenate and 20% organo-arsenic. The pH had little effect over the range of 6.0 to 8.5. Iron and phosphate concentrations significantly affected the arsenic levels. The reduction of ferric to ferrous iron significantly affected the release of the arsenic. It was concluded that adsorption-desorption equi-libria as well as the amount of arsenic available in the muds and sediments greatly affected the solu-

ble arsenic concentration found in the aqueous phase. (Baker-FRC) W81-03826

OF FEEDING. DIRECT IMPORTANCE IMPORTANCE OF FEEDING, DIRECT UPTAKE FROM SEAWATER, AND TRANSFER FROM GENERATION TO GENERATION IN THE ACCUMULATION OF AN ORGANOCHLORINE (P.P-DDT) BY THE MARINE PLANKTONIC COPEPOD CALANUS FINMARCHIMED

CUS, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab. G. C. Harding, W. P. Vass, and K. F. Drinkwater. Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 1, p 101-119, January, 1981. 12 Fig. 3 Tab, 99 Ref.

Descriptors: \*Copepods, \*DDT, \*Absorption, Food chains, Pesticides, \*Path of pollutants, Organic pesticides, Halogenated pesticides, Chlorinated hydrocarbon pesticides, Marine animals, Crustaceans, Toxicity, Phytoplankton, Algae, Zooplankton

The marine copepod, Calanus finmarchicus, accumulated 60-70% of the available DDT when fed Thalassiosira weisflogii labeled with Cl4-p,p'-DDT under normal algae densities (60 micrograms DDT under normal algae densities (60 micrograms C per liter). Under bloom conditions (600 micrograms C per liter) retention was much less, as low as 10%. A preliminary model was developed to include seawater-copepod interaction, feeding and generation transfer terms, as well as to define future research needs for a more complete model. Model simulations indicate that published levels of DDT in copepods could be attained from direct feeding without direct abscention from sea water. feeding without direct absorption from sea water.
Preliminary predictions are that rapidly developing Calanus populations in warm waters will reach an equilibrium bioconcentration after 12 generations. In a two-season temperature environment an alter-nating equilibrium of generations will occur within 4 generations. (Cassar-FRC)

HYDROCARBONS IN AGE-DATED SEDI-MENT CORES FROM TWO BASINS IN THE SOUTHERN CALIFORNIA BIGHT,

California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics. M. I. Venkatesan, S. Brenner, E. Ruth, J. Bonilla, and I. R. Kaplan.

Geochimica et Cosmochimica Acta, Vol 44, No 6, p 789-802, 1980. 5 Fig, 3 Tab, 69 Ref.

Descriptors: \*Hydrocarbons, \*Oil pollution, \*Sediments, Organic compounds, California, San Pedro Basin, San Nicolas Basin, Path of pollutants, DDT, Pesticides, Water pollution sources, Organic matter, Humic acids, Pollutant identification.

Hydrocarbons were measured in dated (1845-1977) sediment cores from San Pedro Basin (inshore, undisturbed sediments) and San Nicolas Basin (offundisturbed sediments) and San Nicolas Basin (offshore, biologically perturbed sediments), both in the Southern California Bight. In the San Pedro core, the top 50 mm (1945-1977) contained 270-2300 micrograms hydrocarbon per g dry sediment and the 75-130 mm section (prior to 1917) about 50 micrograms per g. Total resolved alkanes and aromatic compounds were also more concentrated in the recently deposited sediments; ranges were 4.5-430.1 micrograms per g and 10-1600 micrograms per g, respectively. DDE concentrations were highest in the 1958-67 segment, 3500 ng per g. The more homogeneous San Nicolas sediments had the following levels: aliphatic hydrocarbons. 11-47 mimore nomogeneous San Nicolas sediments nad the following levels: aliphatic hydrocarbons, 11-47 micrograms per g; aromatic hydrocarbons, 11-49 micrograms per g; total resolved alkanes, 1.9-8.6 micrograms per g; and DDE, traces. Potential sources of hydrocarbon input in the San Pedro Basin are industrial municipal wastewater outfall. Basin are industrial municipal wastewater outtain systems, offshore oil production, shipping activities, forest fires, and urban air pollution. The more remote San Nicolas Basin may receive pollutants from both local petroleum seepage and hydrocarbons transported by currents from the north where natural seepage and oil production occur. Most organic matter is of marine origin, as proved by

analyses of kerogens and humic substances. (Cassar-FRC) W81-03859

THE MOBILITY OF THORIUM IN NATURAL WATERS AT LOW TEMPERATURES, Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.

D. Langmuir.
Geochimica et Cosmochimica Acta, Vol 44, No 11, p 1753-1766, 1980. 11 Fig, 1 Tab, 61 Ref.

Descriptors: \*Thorium, \*Natural waters, \*Chelation, Thermodynamics, Path of pollutants, Chemical properties, Physical properties, Organic matter, Seawater, Solubility.

Seawater, Solubility.

Thermodynamic properties of 32 dissolved thorium species and 9 thorium-bearing solid phases were collected from the literature and corrected for 25C and 1 atmosphere pressure. Dissolved This usually complexed in natural waters. Using ligand concentrations typical of groundwater, predominant Th species are Th(SO4)2, ThF2(2+), and Th(HPO4)2 below pH 4.5; Th(HOP4) 3C2-from pH 4.5:7.5; and Th(OH)4 above pH 7.5. Based on stability constants for complexes of Th with citrate, oxalate, and EDTA, it is believed that organic complexes of Th in organic-rich stream water, swamp water, soil horizons, and water-logged recent sediments. Seawater contains Th organic complexes and Th(OH)4. Transport of Th is enhanced in natural waters by inorganic complexing below pH 7 and by organic complexing below pH 8. Th concentrations in fresh waters raverage 0.00064 ppb. This is much greater than the calculated solubility of thorianite in pure water, 0.00001 ppb at pH 5. The concentration of Th is generally limited in natural waters by its scarcity and slow solution rate and by sorption processes, rather than by mineral-solution equilibria. (Cassar-FRC) W81-03863 FRC) W81-03863

U-238 SERIES RADIOACTIVE DISEQUILIBRI-UM IN GROUNDWATERS: IMPLICATIONS TO THE ORIGIN OF EXCESS U-234 AND FATE OF REACTIVE POLLUTANTS,

Physical Research Lab., Ahmedabad (India). N. Hussain, and S. Krishnaswami. Geochimica et Cosmochimica Acta, Vol 44, No 9, p 1287-1291, 1980. 1 Fig. 2 Tab, 18 Ref.

\*Radioactivity, \*Groundwater. Descriptors: \*Groundwater dating, Radioactive tracers, Aging,
\*India, Aquifers, Uranium, Radon, Lead, Thorium, Groundwater movement.

Several groundwater samples were collected from Gujarat, India and analyzed for concentrations of U-238, Th-234, Ra-226, Rn-222 and Pb-210, and U-234/U-238 activity ratios. All samples analyzed except those from Rakhial and Thaltej were from confined aquifers and were collected from tube wells. Takhial and Thaltej samples were from open wells. U-238 concentrations ranged between 2.3 and 16.2 dpm/liter, with relatively higher values in the tube well samples collected near the vicinity of Ahmedabad. U-234/U-238 activity ratios did not show maior variations, ranging between 1.24 and show major variations, ranging between 1.24 and 1.61. Th-234 concentrations in all samples were far less than had been expected from its in situ production in water through the radioactive decay of dissolved U-238. The Rn-222 concentrations ranged between 227-875 dpm/liter. The Rn-222 levels were about three orders of magnitude higher than the activity levels of its parent Ra-226. The large excess of Rn-222 is due to its diffusion and transport through porous soil grains into the aqueous phase. Pb-210 concentrations ranged between 0.0 and 0.14 dpm/liter, very low compared to the activity of its parent Rn-222. The behavior of these elements in groundwaters helps predict that the residence time of other similarly reactive trace metals and pollutants in ground water is only a matter of days. These nuclides have proven to be ideal tracers to study the rates of removal process-es of reactive pollutants in subsurface waters.

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Effects Of Pollution-Group 5C

HUMAN EXPOSURE TO ENVIRONMENTAL TRICHLOROETHYLENE AND TETRACH-LOROETHYLENE: PRELIMINARY DATA ON POPULATION GROUPS OF MILAN, ITALY, Milan Univ. (Italy). Inst. of Hygiene. For primary bibliographic entry see Field 5C. W81-03887.

SALT RELEASE AND MOVEMENT IN PROCESSED OIL SHALE,
Wyoming State Dept. of Environmental Quality,
Cheyenne. Land Quality Div.
D. F. Fransway, and R. J. Wagenet.
Journal of Environmental Quality, Vol 10, No 1, p
107-113, January-March, 1981. 3 Fig, 6 Tab, 9 Ref.

Descriptors: \*Oil shale, \*Salts, \*Solubility, \*Leaching, Shales, Saline water, Calcium, Magnesium, Sodium, Potassium, Chlorine, Sulfates, Leachates, Percolation, Revegetation.

Saline characteristics were studied in Paraho proc-Saline characteristics were studied in Paraho proc-essed oil shale. The shale was mined at Anvil Points, Colorado, and was a component of the Mahogany Zone of the Green River Formation. The processed shale was highly saline, readily leached, and similar to a sandy soil in its moisture release and hydraulic conductivity characteristics. The shale did not display any hydrophobic tenden-cies and would thus be capable of contributing massive quantities of salt to surface and ground waters if enough water was present to leach the massive quantities of sair to surface and ground waters if enough water was present to leach the shale. The application of large pulses of water was most effective in leaching such salts beyond the root zone. It is noted that sieving of the shale for the laboratory study apparently removed a potential salt source. It is suggested therefore that unthat sain source. It is suggested incretore that un-sieved shale be used in future experimentation. Proper management of applied irrigation water can be used to effectively reduce salt levels in the upper rooting zone of the shale, thus rendering upper rooting zone of the shale, thus rendering revegetation possible. If excess water is not applied, the salts will not be leached to the ground waters, but will remain in the shale pile. Upward salt migration during evaporation periods did not appear to occur. (Baker-FRC) W81-03897

HYDROCARBONS OF AQUATIC AND TER-RESTRIAL ORIGIN IN MOUNTAIN STREAMS

OF THE MARMOT BASIN, Calgary Univ. (Alberta). Kananaskis Center for Environmental Research. For primary bibliographic entry see Field 5A. W81-03898

PROBLEMS PLAGUE HAZARDOUS WASTE

DISPOSAL, Wei (Norman S.) and Associates, Ltd., Toronto (Ontario). For primary bibliographic entry see Field 5E. W81-03947

#### 5C. Effects Of Pollution

INFLUENCE OF STREAMFLOW REDUCTIONS ON SALMONID EMBRYO DEVELOP-

MENT AND FRY QUALITY, Idaho Cooperative Fishery Unit, Moscow. D. W. Reiser, and R. G. White. Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215626, Price codes: A08 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, University of Idaho Project Completion Report, March, 1981. 154 p. 33 Fig. 25 Tab, 63 Ref. 5 Append. OWRT-A-058-IDA(1), 14-34-0001-116

Descriptors: \*Streamflow, \*Streambeds, \*Salmon, \*Embryonic growth stage, Sediment distribution, Incubation, Marine animals, Streamflow depeletion, Streams, Flow, River beds, Submerged beds, Fish, Growth stages, Hazards, Gravel, Sediments, Hatching, Aquatic animals, Aquatic life, Aquatic environment, Aquatic populations.

The program was designed to examine effects of streamflow reduction on salmonid embryo incuba-

tion success, to determine if extragravel parameters tion success, to determine it extragraves parameters could be adequately related to the intergravel environment, and to develop a methodology for recommending embryo incubation flows. Both field (utilizing sections of two creeks) and laboratory (run in artificial stream channels and in incubation chambers) tests were conducted from 1977-1979. Reductions in streamflow over redds (chinook salmon and steelhead trout) containing sediment (less than 0.84 mm) in quantities from 3-13% resulted in increased embryo mortality (with greatest increases associated with levels of 7% sediment being less than 0.84 mm), and retarded developbeing less than 0.54 min), and related development of embryos resulting in alevins. Sediment sizes less than 0.84 mm were the most deleterious to embryo survival. Water depths and velocities over redds are poor indicators of intergravel velocities, and thus of little use in predicting embryo survival. Incubation flow recommendations based on computations using the U.S. Fish and Wildlife Services Instream Flow Group technique should provide for suitable incubation velocities. (Zie-W81-03606

TABLE ROCK TAILWATER TROUT FISHERY -- VALUE, USE, AND DISSOLVED OXYGEN PROBLEM,

PROBLEM, Missouri Dept. of Conservation, Columbia. A. S. Weithman, J. R. Whitley, and M. A. Haas. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 8. 9 p, 3 Ref.

Descriptors: \*Dissolved oxygen, \*Sport fishing, \*Trout, \*Economic aspects, Water temperature, Water quality, Hypolimnion, Reservoir releases, Social values, Economic aspects, Recreation, \*Lake Taneycomo, Missouri.

Lake Taneycomo (Table Rock Tailwater) was transformed from a warmwater to a coldwater lake in 1958 when Table Rock Dam was constructed upstream. Dissolved oxygen concentrations below 6 mg/l have been measured in upper Lake Taney-como periodically each fall since 1959. The low levels are caused by the discharge of oxygen deficient water from the hypolimnion of Table Rock Lake. In order to determine and quantify the effects of verying leaving of discharge on the Lake. In order to determine and quantity the effects of varying levels of dissolved oxygen on the Lake Taneycomo trout fishery, a study was made of socioeconomic value of the fishery, and angler success. The consumer surplus was estimated to be \$9.2 million for the Lake Taneycomo fishery. An increase in angler success is directly and linearly related to an increase in the minimum daily level of dissolved oxygen when it is below 6 mg/l or an dissolved oxygen when it is below 6 mg/l or an increase in angler experience when dissolved oxygen exceeds 6 mg/l. A change in dissolved oxygen of 1 mg/l will result in an increase or decrease in catch and harvest rates of about 0.1 trout per hour. The seasonal dissolved oxygen deficit is 2.1 mg/l, yielding an estimate of 42,000 hours of fishing lost, or a total of 9,130 days because of low levels of dissolved oxygen. The value of this recreation lost to anglers and the area economy is currently estimated to be about \$350,000 per year based on the consumers surplus approach. (Moore-SRC) W81-03647

ENVIRONMENTAL ASPECTS OF RESERVOIR RELEASES,

Army Engineer Div. South Atlantic, Atlanta, GA. G. M. Strain.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 13. 16 p, 13 Fig,

Descriptors: \*Reservoir releases, \*Dissolved oxygen, \*Environmental effects, Reservoir operation, Hydroelectric power, Water quality, Water temperature, Low flow, Hypolimnion, Hydrological regime.

Environmental concerns have been expressed for the downstream effects of releases from Corps of Engineers reservoirs in the Southeast. Hydrologic

flow regime changes downstream of reservoirs can impact fishery habitat, wastewater discharge requirements, migration of anadromous fish, river swamps, wetlands, and scouring actions of the sites and increased turbidity. Anoxic conditions in the handlinging of dear-converse. hypolimnion of deep reservoirs in the Southeast combined with low level outlet works for hydropower operations produce a major water quality area of concern. Seven reservoirs in the Southeast area of concern level reservoirs in the solutions periodically release water of reduced quality. The primary parameter of concern has been dissolved oxygen. All of these reservoirs primarily release water through their hydropower plants. The hydraulic head is used to create electricity and is not draulic head is used to create electricity and is not available for reacration. This demonstrates a direct conflict between energy and environmental concerns. Limited water quality control capability is provided at two of the seven projects mentioned above. The duration of low dissolved oxygen levels in the releases is generally about 4-6 months per year. The reach of river required for reaeration to water quality standards is variable but ranges from abou? 2 to 20 miles. In cases where minimum low flows are provided, generally the water quality of the releases is better at low flow than high flow. The dissolved oxygen concentration and temperature of the releases from Buford Dam during peaking hydropower operations are higher during peaking hydropower operations are higher than during low flows. Futhermore, the reach of river required to reacrate to water quality stand-ards during high flow at Buford Dam is significant-ity longer than during low flow. No significant fish kills have been observed in the river below Buford kills have been observed in the river below Bullord Dam. It has been hypothesized that reduced toxic constituents produced in the anoxic hypolimnion of Lake Lanier (Buford Dam) remained as residuals after short term aeration to cause the fish kill in the hatchery. The hydraulic structure at W. Kerr Scott Lake demonstrates an exceptional ability for reaeration of the release waters. (Moore-SRC)

SUPERSATURATION AT RESERVOIR PROJECTS.

Corps of Engineers, Omaha, NE. Missouri River

H. O. Reese H. O. Reese.
In: Proceedings of a Seminar on Water Quality
Evaluation, 22-24 January, 1980, Tampa, Florida.
Army Corps of Engineers, Committee on Water
Quality, Washington, DC., paper 15. 8 p.

Descriptors: \*Supersaturation, \*Fishkill, \*Reservoir releases, Dissolved oxygen, Nitrogen, Carbon dioxide, Argon, Bubbles, Water pressure, Hydraulic structures, Entrainment, Environmental effects,

Gas supersaturation has been identified as a potential environmental problem associated with releases from Army Corps of Engineers impoundment projects. Incidents of fish mortality have been attributed to this dissolved gas problem. Fish mortality has been experienced below projects on the Snake and Columbia Rivers, and downstream of the partially completed Harry S. Truman project on the Osage River. The degree of gas super-saturation below a hydraulic structure is primarily set on the Osage River. In degree of gas aspei-saturation below a hydraulic structure is primarily dependent on the type of structure, depth of water in plunge pool, and magnitude of flow. Nitrogen, oxygen, argon, carbon dioxide and other gases of air become dissolved in water under pressure when air is entrained with water as small bubbles and subsequently placed under pressure. Laboratory tests show that fish mortality from gas bubble disease is related to the level of total dissolved gas pressure and the time of exposure. Tolerance to supersaturation varies between fish species. The major fish kills experience resulted from gas saturation levels in the range of 120 to 140%. (Moore-SRC) W81-03653

WATER QUALITY EVALUATION - AN ES-TUARINE CASE STUDY, Army Engineer Div. South Pacific, San Francisco,

J. P. Sustar. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 17. 9 p.

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5C-Effects Of Pollution

Descriptors: \*Estuarine environment, \*Dredging, \*Water quality, Waste disposal, Physical properties, Biological properties, Chemical properties, Environmental effects, \*San Francisco Bay.

An interdisciplinary applied research program on the impacts from dredging operations in San Francisco Bay has resulted in the complete reorganization of the permitting of dredging operations. The following premises guided the study: the success of a study depends on how well the specific environmental impact questions were refined as the study progressed; generalized statements on the waste would lead to invalid conclusions; changes in chemical biological and some physical baseline conditions in an estuarine system can not be used to interpret direct cause and effect relationships in the system; the study of impacts must separate or isolate causes of those impacts to the greatest extent possible; and definition of the system is essential for transfer and correlation of information between work elements within the study and between studies in other systems and environments. The study was set up in three tiers. The first tier was aimed at defining the physical, chemical, biological and mechanical systems associated with the dredging and disposal operations in San Francisco Bay. The second tier study elements addressed the relationships between each of the four systems. The third tier elements addressed the relationships between all of the four systems which resulted in an interpretation of mechanisms of action in the estuary during the dredging and disposal, what parameters appeared to control the events and what could be expected during future operations. (Moore-SRC)

DETERMINING THE AVAILABILITY OF SEDIMENT-BOUND TRACE METALS TO AQUATIC DEPOSIT-FEEDING ANIMALS, Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 5B. W81-03728

CADMIUM IN FOLIAGE ALTERS PLANT RE-SPONSE TO TOBACCO MOSAIC VIRUS, New Jersey Agricultural Experiment Station, New Brunswick. For primary bibliographic entry see Field 5E. W81-03754

RESPONSE OF BENTHIC COMMUNITIES IN MERL EXPERIMENTAL ECOSYSTEMS TO LOW LEVEL, CHRONIC ADDITIONS OF NO 2 FUEL OIL, Woods Hole Oceanographic Institution, MA.

Woods Hole Oceanographic Institution, MA. J. F. Grassle, R. Elmgren, and J. P. Grassle. Marine Environmental Research, Vol 4, No 4, p 279-297, 1981. 13 Fig, 3 Tab, 10 Ref.

Descriptors: \*Benthic fauna, \*Water pollution effects, \*Oil, Ecosystems, Fauna, Marine environments, Toxicity, Marine sediments.

The macrofauna and meiofauna of three oiled and three control experimental ecosystems at the Marine Ecosystems Research Laboratory (MERL) were followed for 25 weeks of semi-continuous additions of an oil-water dispersion of No 2 fuel oil. The benthic components of the experimental ecosystems were similar in structure to the original Narragansett Bay community, replicated well, and did not show erratic fluctuations in abundances of individual species. Low additions of the fuel oil to the experimental ecosystems had a highly significant effect on total macrofaunal numbers when compared with controls. Each of the most common species showed significant differences in population density between oiled and control tanks. The MERL tanks supported a meiofaunal community similar to that of the Bay for 10 months, after which a clear decline in abundance took place even in the control tanks. The larger macrofaunal animals sampled by sieving all of the sediment showed highly significant differences in total fauna, but most particularly a reduction in suspension feeders in the oiled tanks. The oil levels

used in the MERL tanks brought about a drastic reduction in the metazoan meiofauna after 5 months. The microcrustacea seemed to be the most sensitive groups. Unicellular meiofauna increased in the oiled tanks, probably due to decreased predation and competition. After less than 2 months without oil additions, a strong recovery was found in the harpacticoid copepods, and other meiofaunal groups also showed signs of recovery. The macrofauna showed no signs of recovery in the oil tanks during these 2 months. (Carroll-FRC)

EFFECTS OF RAPID CHANGES IN TEMPERA-TURE ON TWO ESTUARINE CRUSTACEANS, Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab. D. T. Burton, T. P. Capizzi, S. L. Margrey, and W. W. Wakefield.

Marine Environmental Research, Vol 4, No 4, p 267-278, 1981. 3 Fig, 2 Tab, 30 Ref.

Descriptors: \*Oxygen requirements, \*Temperature effects, \*Marine animals, Amphipods, Gammarus, Crabs, Crustaceans, Thermal stress, \*Thermal pollution, Powerplants.

The potential thermal impact on aquatic organisms from steam electric generating stations with once-through cooling systems has created considerable concern. Previous studies of the effects of thermal pollution are not useful for predicting the impact on organisms which are entrained through plants using multi-port diffusers or submerged jet discharges to achieve rapid temperature reductions. This study examined the weight specific oxygen consumption patterns of the amphipod, Gammarus sp. (acclimated to 5C, 15C, and 25C), and of juvenile blue crabs, Callineteets sapidus (15C and 25C), in an effort to evaluate the potential effect of exposure to rapid temperature changes simulating once-through power plant pumped entrainment terminating in high velocity submerged jet discharges. Amphipods at all acclimation temperatures and blue crabs at 15C responded to the temperature changes by increasing their weight specific oxygen consumption above pre-exposure levels after the thermal increase and then returning to pre-exposure levels. The response was judged to be a normal physiological compensation response, not a thermal stress response. Significant differences were found among seasonal oxygen consumption patterns in both species, with weight-specific oxygen consumption increasing with increased acclimation temperature changes. This implies that the effects of rapid temperature changes up to 10C from power plants of this design should have no significant impact on these organisms. (Carroll-FRC)

ACUTE TOXICITY OF A USED CHROME LIGNOSULPHONATE DRILLING MUD TO SEVERAL SPECIES OF MARINE INVERTEBRATE, Texas A and M Univ., College Station. Dept. of Biology.

Biology.

J. M. Neff, R. S. Carr, and W. L. McCulloch.

Marine Environmental Research, Vol 4, No 4, p
251-266, 1981. 6 Tab, 39 Ref.

Descriptors: \*Toxicity, \*Chromium, \*Marine animals, Lignite, Sulfonates, Sulfates, Seawater, Crustaceans, Mollusks, Aquatic animals, Annelids, Suspended solids, Clays, Sublethal effects, Drilling, Drilling fluids.

The acute toxicity of a used seawater chrome lignosulfonate drilling mud to several species of marine annelids, crustaceans, and mollusks was evaluated. The medium density mud (13.4 pounds per gallon) was composed primarily of seawater, bentonite clay, chrome lignosulfonate, lignite, sodium hydroxide, and barium sulfate. The toxicity of four mud/seawater preparations was determined. These were the layered solids phase, the suspended solids phase, the unfiltered mud aqueous fraction, and the filtered mud aqueous fraction. The medium lethal concentration of the unfiltered fraction (96-hour LC50) varied from 32 to greater

than 100 percent of the unfiltered fraction for different species. The filtered fraction was slightly less toxic than the unfiltered fraction. The suspended solids phase preparation at concentrations of 10 to 20 milliliters per liter was toxic to post-larvae and juveniles of some commercial shrimp. Exposure to the layered solids phase preparation caused greater than 50 percent mortality among three species, although other species were quite tolerant. A sublethal response observed was inhibition of reproduction in some marine annelids. Toxicity of the mud aqueous fractions appeared to be due primarily to volatile soluble organic materials in the extract, while that of the layered and suspended solids phase preparations appeared to be due to the smothering action of fine particulates in the mud. It is concluded that discharge of a used chrome lignosulfonate drilling mud such as that used in this study from offshore platforms is not likely to cause measurable damage to benthic, demersal, or pelagic marine animals. (Carroll-FRC) W81-03778

THE EFFECTS OF SYNTHETIC CRUDE OIL ON MICROBIAL AND MACROINVERTE-BRATE BENTHIC RIVER COMMUNITIES. PART I: COLONISATION OF SYNTHETIC CRUDE OIL CONTAMINATED SUBSTRATA, Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

M. A. Lock, R. R. Wallace, D. R. Barton, and S. Charlton.

Environmental Pollution (Series A), Vol 24, No 3, p 207-217, March, 1981. 2 Fig, 2 Tab, 31 Ref.

Descriptors: \*Benthic environment, \*Oil, \*Water pollution effects, Rivers, \*Oil spills, Microbiological studies, Invertebrates, Algae, Bacteria, Chlorophyll, Diatoms, Measurement techniques, Food chains, Light quality.

Studies concerning the effects of oil spills upon microbial and macroinvertebrate benthic river communities are few. This study was designed to examine the response of a northern brown-water river community to synthetic crude oil, which is the end product of the oil sands extraction process, under light and dark regimes. An acute, short-term synthetic crude oil spill was simulated by dipping limestone bricks into the oil and then examinig their microbial and macroinvertebrate colonization under conditions of light and dark. A reduction to less than 0.3% of surface radiation in the dark resulted in a non-significant reduction of algae as compared to samples in the light. On oiled bricks in the light compared with the controls, there was an increase in the bacterial numbers by a factor of 9, an increase in chlorophyll a by a factor of 9, an increase in diatoms by a factor of 5.6, and an increase in blue-green algae by a factor of 0.7. Significant increases were also noted in the tri-chopteran Lepidostoma, the Chironomidae, and the Naididae. On oiled bricks in the dark, the only significant changes were an increase in numbers of bacteria and Tanypodinae and a reduction in Gas-tropoda and Bactis sp.; all other parameters did not differ significantly from the control. It therefore appears that synthetic crude oil has a stimulatory action upon bacteria, algal, and macroinvertebrate benthic colonization, but one that is not apparent under conditions of low light. The traditional approach of assessing the impact of a pollutant through the use of indicator species needs to be reconsidered to include the supporting food web. (Carroll-FRC) W81-03779

THE EFFECTS OF SYNTHETIC CRUDE OIL ON MICROBIAL AND MACROINVERTE-BRATE BENTHIC RIVER COMMUNITIES: PART II-THE RESPONSE OF AN ESTABLISHED COMMUNITY TO CONTAMINATION BY SYNTHETIC CRUDE OIL,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

M. A. Lock, R. R. Wallace, D. R. Barton, and S. Charlton.

Environmental Pollution (Series A), Vol 24, No 4, p 263-275, 1981. 5 Fig, 4 Tab, 12 Ref.

#### Effects Of Pollution-Group 5C

Descriptors: \*Benthos, \*Oil, \*Rivers, Benthic flora, Benthic fauna, Water pollution effects, Oil spills, \*Oil pollution, Environmental effects.

In order for oil spilled into a river to have prolonged effect upon the benthic river community, the oil must adhere to the surface of the rock and gravel in the river bed and must penetrate the layer of periphyton which coats the rock and gravel. The response of an already established microbial and macroinvertebrate community growing on ar-tificial limestone substrates to an addition of synthetic crude oil and its component fractions (naph-tha, kerosene, and gas/oil) was investigated. Some limestone bricks which had been placed into a riffle section of a brown-water river to become colonized by benthic flora and fauna were then dipped into the oils. Community changes on oiled and unoiled bricks were monitored for a period of 161 days through the summer, autumn, and winter. The response to the oil was minimal. Bacterial The response to the oil was minimal. Bacterial numbers and amounts of chlorophyll a were slightly increased on bricks treated with some of the oils. Numbers of diatoms and blue-green algae were generally about the same on treated and untreated bricks. The few significant differences in the responses of macroinvertebrates indicated that there were no great shifts in community structure in response to the oil contamination. The study in response to the oil contamination. The study findings suggest that although a massive light oil spill into running freshwater will have an initial detrimental effect on fish and benthos, the long-term effects on the benthic flora and fauna encountered in the mid-channel of stony riffles with turbu-lent flow and a nearby refugium from which reco-lonization could occur could be negligible. (Carroll-FRC) W81-03780

ASBESTOS-CEMENT MATERIALS USED IN

WATER SUPPLY, Health Effects Research Lab., Cincinnati, OH. For primary bibliographic entry see Field 5B. W81-03789

EFFECTS OF INTERMITTENT CHLORINA-TION ON PLASMA PROTEINS OF RAINBOW TROUT (SALMO GAIRDNERI),

James Madison Univ., Harrisonburg, VA. Dept. of P. M. Booth, Jr., C. M. Sellers, Jr., and N. E.

Garrison.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 2, p 163-170, 1981. 2 Fig.

Descriptors: \*Trout, \*Chlorine, \*Powerplants, Cooling towers, Chlorination, Cooling water, Re-sidual chlorine, Fish, Proteins, Blood, Bioindica-

Changes observed in the plasma protein profiles of trout exposed to chlorine in intermittent pulses, as would be the case if the fish were downstream from a power plant, are reported. Prior to chlorine exposure, 13 major protein bands were ascertained in all experimental and control fish. Using bands 6 in all experimental and control fish. Using bands 6 and 13 as markers, all bands previously reported by other investigators were detected. The deletion of bands 7, 10, and 12 following chlorine exposure, indicative of altered blood protein composition, suggests that chlorine is toxic to these fish under these conditions. The greatest effect was noted with 0.22 mg/liter total residual chlorine, which appeared to be the rainbow trout's lethal limit. Exposure to this concentration resulted in several responses which had been previously reported, such as coughing and gulning for air, which individual completions for air, which indisuch as coughing and gulping for air, which indi-cates apparent hypoxia. Chlorine exposure apparently reduced respiratory gas exchange. Darker, more viscous blood appeared within 4 hr following onset of chlorine exposure. Protein 7, previously identified as ceruloplasmin, is necessary for hemoglobin formation to occur. The deletion of this protein may indicate altered hemoglobin formation, which would in turn inhibit oxygen transport.

A general increase in proteins 1-6 was also noted.

Band 4 was identified as transferrin, a protein responsible for iron transport. Proteins 2 and 3, umins, function in osmotic pressure regulation (Baker-FRC)

TOXIC EFFECTS IN FISH AND THE MUTA-GENIC CAPACITY OF WATER FROM THE SAVA RIVER IN YUGOSLAVIA, Institut Rudjer Boskovic, Zagreb (Yugoslavia). B. Kurelec, M. Protic, S. Britvic, N. Kezic, and M.

Bulletin of Environmental Contamination and Toxicology, Vol 26, No 2, p 179-187, 1981. 5 Tab,

Descriptors: \*Water quality, \*Monitoring, \*Rivers, Sava River, \*Yugoslavia, Xenobiotics, Fish, Indicators, Bioindicators, Carcinogens, Toxicity, Muta-

Both early and late toxic effects occurring in fish in the Sava River in Yugoslavia were examined. Early toxic effects included the induction of benzo(a)pyrene monooxygenase (BPMO) activity in natural fish populations. Late effects included the appearance of tumors in the fish. The five species living in the investigated segment of the Sava River were highly induced with respect to their liver BPMO activities. While a good correlation was obtained between the quality of water and the state of induction of BPMS activity, no correlation to low water quality was noted with frequency of neoplasms in the wild population of fish. Therefore, this population of fish, expected to be at highest risk, did not exhibit the expected neoplasms. Thus, monitoring of tumor frequency in fish, and the subsequent use of the information gained as the sole sentinel organism for detection of waterborne mutagens and/or carcinogens does not appear to be a reasonable choice. (Baker-FRC) W81-03809 Both early and late toxic effects occurring in fish

FREE AMINO ACIDS IN MANTLE TISSUES OF THE BIVALVE AMBLEMA PLICATA: POS-SIBLE RELATION TO ENVIRONMENTAL STRESS,

Columbia National Fisheries Research Lab., MO. W. S. Gardner, W. H. Miller, III, and M. J. Imlay. Bulletin of Environmental Contamination and Toxicology, Vol 26, No 2, p 157-162, 1981. 2 Tab,

Descriptors: \*Acid mine drainage, \*Mollusks, Mine drainage, Acid streams, Amino acids, Mus-sels, Stream pollution, Streams, Natural streams, \*Toxicity.

The composition and concentration of free amino acids were investigated in mantle tissues of Amblema plicata. The purpose was to determine whether free amino acid patterns in the tissues of freshwater bivalves can reflect adverse conditions in stream habitats. Thus, bivalves in selected polluted stream habitats. Thus, bivalves in selected polluted and relatively unpolluted Missouri streams were investigated. Cedar Creek, one of the sample locations, has a history of receiving acid coal mine drainage. Gasconade River, another sampling point, is a relatively clear stream containing diverse biological populations. A similar pair of sampling points was made up of the metal-contaminated Big River and the relatively clear Bourbeuse Bitage Siries Siries and the better feet agrical content. River and the relatively clear bourbeuse River. Significantly higher free amino acid concentrations were found in the metal polluted Big River mussels than in the Bourbeuse River controls. Differences were not as pronounced in the Cedar Creek-Gasconade River comparison. The total levels of free amino acids in mantle tissues of A. plicata were substantially lower than were previously reported for marine bivalves. Glycine and taurine, which occur at high levels in marine invertebrates, were not elevated in A. plicata and did not show measurable compositional differences in animals from polluted and control streams. In contrast to marine bivalves, in which stressed animals had lower concentrations of most amino acids than nactiower concentrations of most amino actors than controls, A. plicats amples from acid mine drain-age-contaminated streams had higher concentra-tions of free amino acids in their tissues than did those collected from control streams. (Baker-FRC)

A REEVALUATION OF THE TOXICITY OF COAL CONVERSION PROCESS WATERS, Oak Ridge National Lab., TN. Environmental Sci-

ences Div. B. R. Parkhurst, J. S. Meyer, G. M. DeGraeve, and H. L. Bergman

Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 9-15, 1981. 4 Tab, 6

Descriptors: \*Coal, \*Effluents, \*Toxicity, Wastewaters, Industrial wastes, Ammonia, Phenol, Daphnia, Crustaceans, Hydrocarbons.

Daphnia, Crustaceans, Hydrocarbons.

This paper aims to clarify the role of ammonia in the toxicity of complex coal conversion wastewaters, to reevaluate the toxic contribution of ammonia in the treated hydrocarbonization (HcZ) effluent, and to compare these results with literature reports for other coal conversion effuents. Recent findings indicate an approximately additive or slightly greater than additive combined toxicity for the treated HcZ effluent components, since the 95% confidence interval of the index overlaps zero. This findings conflicts with earlier thoughts that the toxicity of ammonia in the treated HcZ effluent was less than additive, and emphasizes the importance of assessing ammonia toxicity from non-ionized rather than total ammonia concentrations. The coal conversion effluents reviewed in this paper, phenol and non-ionized ammonia, were the dominant toxic components. The additivity of their toxicities was similar for the fish and Daphnia species tested. It is suggested that additivity of their toxicities was similar for the fish and Daphinia species tested. It is suggested that coal conversion effluents may be expected to contain high concentrations of both ammonia and phenol. The LC50 dilutions of these process waters can be predicted from the individual LC50 concentrations of the major toxic components, the contrations of the major toxic components, the con-centrations of these components in the effluents, and the pH and buffering capacities of dilution waters. (Baker-FRC) W31-03811

EFFECTS OF A DRILLING FLUID ON THE DEVELOPMENT OF A TELEOST AND AN

DEVELOPMENT OF A TELEUST AND AN ECHINODERM,
Trinity Coll., Hartford, CT. Dept. of Biology.
R. B. Crawford, and J. D. Gates.
Bulletin of Environmental Contamination and
Toxicology, Vol 26, No 2, p 207-212, 1981. 4 Tab.

Descriptors: \*Drilling fluids, \*Marine waters, \*Aquatic animals, Oil industry, Estuarine environ-ment, Estuaries, Growth stages, Echinoderms, Growth, Water pollution effect.

Initial phases of a study on the effects of a sample of drilling fluid on the development of a teleost and an echinoderm embryo are reported. The drilling fluid used was Control No. 16, 11, collected in ing fluid used was Control No. 16, 11, collected in June 1979. The sample was a lignosulfonate-mud type containing barium sulfate. Embryos of Fundulus heteroclitus (Linnaeus) were used as the model for teleost development studies. Embryos of the sand dollar Echinarachnius parma were used as the model for echinoderm development studies. In the early stages the drilling fluid appeared to have no effect on Fundulus development. However, by the 7th day marked effects were noted at higher con-centrations. Embryos in 10 pnt drilling fluid develcentrations. Embryos in 10 ppt drilling fluid developed very slowly from the 7th to the 16th day, by which time their growth was completely arrested. By day 21 they were all dead. At 1 ppt develop-ment rate and heart beat were slowed, but these caught up with controls by the late stages of the caught up with Controls by the late stages of the study. Sand dollar development was normal at concentrations up to 100 ppm. At 10 ppt all embryo development was delayed and then arrested at the blastula stage. Sand dollar fertilization was affected by 15 min preincubation of gametes in drilling fluid. Treatment of the sperm did not affect fertilization arrests 10 pts. The the drilling fluid. fertilization, even at 10 ppt. Thus the drilling fluid affected the development of the teleost and the fertilization and development of the sand dollar. (Baker-FRC) W81-03813

REPRODUCIBILITY OF A LIFE-CYCLE TOX-ICITY TEST WITH DAPHNIA MAGNA, Oak Ridge National Lab., TN. Environmental Sci-

B. R. Parkhurst, J. L. Forte, and G. P. Wright.

Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 1-8, 1981. 7 Tab. 14

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5C-Effects Of Pollution

Descriptors: \*Testing procedures, \*Toxicity, \*Daphnia, Crustaceans, Life cycles, Effluents, Wastewater, Industrial wastes, Statistical analysis.

Experiments were performed to determine whether LRCTs (lowest rejected concentration tested) obtained from six different toxicity criteria in static-renewal tests with the chemical acridine and Daphnia magna were reproducible over time and to determine the relative sensitivity and variability of the toxicity criteria. Toxicity criteria used were survival, two indices of maturation, and three indices of reproduction. The estimated LRCTs ranged between 0.8 and 3.2 mg/liter of acridine in the four tests. The LRCTs estimated for the toxicity criteria of survival, age at onset of reproduction, and number of broods produced per female varied significantly among the four tests, and thus the LRCTs estimated from these toxicity criteria were not reproducible using the accepted definition of reproducibility. However, the LRCTs estimated for occurrence of primiparous instar, number of young per brood, and number of young produced per female did not change at all in the four tests. Thus LRCTs using these criteria were reproducible. The latter two were the most sensitive for estimating the LRCT, as their LRCT (0.8 mg/liter) was less than the value for occurrence of the primiparous instar (1.6 mg/liter). It was concluded that two of the six toxicity criteria, the number of young/brood and the young produced/female, were the most reliable and sensitive for estimating the LRCT for acridine to D. magna. (Baker-FRC) W81-03814

EFFECTS OF ACID IRRIGATION AND LIMING ON TWO CLONES OF NORWAY SPRUCE.

Norwegian Forest Research Inst. G. Ogner, and O. Teigen. Plant and Soil, Vol 57, No 2/3, p 305-321, 1980. 7 Fig. 13 Ref.

Descriptors: "Acidic water, "Irrigation water, "Lime, Water pollution, "Norway, "Spruce trees, Plant growth, Coniferous trees, Trees, Resistance, Sulfuric acid, Calcium carbonate, Aluminum, Calcium, Manganese, Iron, Potassium, Sulfur, Sulfates, Magnesium, Nitrogen compounds, Phosphorus compounds, Clones.

Two Norway spruce clones were treated with H2SO4 acidified water (pH 5.4, 4.0, 3.0, and 2.5). All plants grew well for the duration of the experiment, 3 growing seasons, 1975-1977. The pH 2.5 irrigated plants were more yellowish in color. Of 120 plants, 5 died for undeterminable reasons. Ground vegetation, mosses and ferns, decreased with increasing acidity of water. No ferns were present below 3.5. Concentration of P, K, S, Mg, Ca, and Mn in the needles was within the optimum range; Al, total S, and sulfate were high when water of pH 2.5 was applied. Nitrogen concentration was clearly suboptimum. As soil acidity increased, lesser amounts of Ca, Fe, and Mn were taken up by the plants. Of the two clones, both from the same tree, H254 grew better than H253, and produced differences in soil constituents. Application of CaCO3 to the soil had no beneficial effects on growth, nor did acid water irrigation cause any harmful effects to the acid-tolerant Norway spruce. (Cassar-FRC) W81-03822

IN SITU CELL DEPLETION OF SOME MARINE ALGAE ENCLOSED IN DIALYSIS SACKS AND THEIR USE FOR THE DETERMINATION OF NUTRIENT-LIMITING GROWTH IN LIGURIAN COASTAL WATERS (MEDITER-RANEAN SEA).

Centre d'Oceanographic, Marseille (France). Station Marine d'Endoume.

S. Y. Maestrini, and M-G. Kossut. Journal of Experimental Marine Biology and Ecology, Vol 50, No 1, p 1-19, 1981. 4 Fig, 7 Tab, 45 Ref.

Descriptors: \*Algal growth, \*Limiting nutrients, \*In situ tests, Natural waters, Phosphorus, Nitrogen, Seasonal variation, Water pollution effects.

This study investigated whether cells obtained by in situ culturing in nutrient-poor waters showed a biochemical composition similar to the one of natural algae, and if the in situ cells are still capable of dividing when subcultured. The experiments were conducted in coastal Ligurian waters close to the Laboratorio per lo Studio della Contaminazione Radioattiva del Mare, south of La Spezia, Italy. Five cultured strains were used: one prasinophyte isolated from the Ligurian Sea, three bacillario-phytes, Thalassiosira pseudonana, Scletonema costatum, and one chrysophyte. The cells were kept in directly immersed dialysis sacks until they divided at least five times. A daily count of cell density was used to determine growth. During late spring and early summer, phosphorus was the limiting nutrient in algae growth. Some variations were observed. Most algae were permanently limiting buring adjustment to equilibrium with natural waters, the cultured algae became improverished in phosphorus, ATP, and chloro-phyll alpha. (Small-FRC)

EFFECT OF BORON ON PRIMARY PRODUC-TION OF NANOPLANKTON, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.

D. V. Subba Rao.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 1, p 52-58, January, 1981. 2 Fig, 3 Tab, 18 Ref.

Descriptors: \*Boron, \*Phytoplankton, \*Nutrients, Nanoplankton, Photosynthesis, Primary production, Water pollution effects, Aquatic algac, Nitrates, Phosphates, Saline water, Seasonal, Speciation.

Experimental addition of boron (30 micrograms per liter) to sea water enhanced (to a maximum of 168%) primary production and carbon assimilation rates of natural populations of nanoplankton (20 micrometer fractions of phytoplankton) during November-May when nitrates, phosphates, and silicates were at high levels and temperatures were low. Photosynthesis was inhibited (to a maximum of 62%) during June-October when nutrients were low and temperature high. Primary production in controls ranged from 0.29 mg C per cu meter per hour on Dec. 16, 1977, to 113.41 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on Dec. 16, 1977, and 46.83 mg C per cu meter per hour on June 19, 1977. In unalgal cultures, boron inhibited photosynthesis in 14 day old cultures of some species, showing some species dependence. If boron pollution is present (from pulp and paper mill effluents, etc.), variations in phytoplankton species composition may be expected. (Cassar-FRC)

TIN AND TIN-RESISTANT MICROORGAN-ISMS IN CHESAPEAKE BAY, Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.

Maryland Univ., Solomons. Center for Environmental and Estuarine Studies. L. E. Hallas, and J. J. Cooney. Applied and Environmental Microbiology, Vol 41, No 2, p 466-471, February, 1981. 1 Fig, 5 Tab, 23 Per

Descriptors: \*Tin, \*Microorganisms, \*Adaptation, Organotin compounds, \*Chesapeake Bay, Sediments, Water analysis, Water pollution effects, Environmental effects, Ecotypes.

Water samples collected at 9 stations in Chesapeake Bay contained less than 0.002 mg tin per liter, with the exception of 3 samples ranging from 0.023 to 0.152 mg per liter. However, sediment samples from Baltimore Harbor, site of shipping and heavy industry, contained high levels of tin (239.6 mg per kg). Intermediate levels (3.0-7.9 mg per kg) were detected in sediments from other sites impacted by human activity, and low levels in open water sediments (0.8-09 mg per kg). All sites in the Bay contained microorganisms resistant to tin. Toxicity of tin to the microbial populations

depended greatly on chemical species; inorganic tin (75 mg per liter) decreased cell counts significantly in agar medium but not in silica gel solidified medium. The microbial flora was more sensitive to organic tin compounds (dimethyl tin dichloride) than to inorganic tin, SnCl4. Twelve to 55% of the microbes were resistant to inorganic tin; 0 to 11% to organotin compounds. (Cassar-FRC) W81-03849

HUMAN EXPOSURE TO ENVIRONMENTAL TRICHLOROETHYLENE AND TETRACH-LOROETHYLENE: PRELIMINARY DATA ON POPULATION GROUPS OF MILAN, ITALY, Milan Univ. (Italy). Inst. of Hygiene.

G. Ziglio.

Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 131-136, 1981. 3 Tab, 12 Ref

Descriptors: \*Well water, \*Contamination, \*Organic solvents, Human population, Trichloroethylene, Tetrachloroethylene, \*Milan, Italy, Trichloroacetic acid, Monitoring, Blood, Water pollution sources, \*Drinking water, Water pollution effects.

A study group of 24 persons living in Milan was examined for trichloroethylene (TRI) and tetrachloroethylene (PER) ingested via their drinking water. Plasma levels of trichloroacetic acid (TCA) were calculated, as this is a metabolite common to both chemicals. For the period June-July 1978 levels of TCA in exposed populations (drinking water from contaminated wells) were higher than in individuals who were not exposed. Plasma levels of TCA were higher in winter than in the summer. Concentrations of TRI and PER in the atmosphere were also higher in the winter than in the summer concentrations of PIR and PER in the immediate vicinities of dry-cleaning facilities were consistently shown to be twice those measured in urban areas further away from the source. Thus the validity of plasma TCA as a tracer for monitoring chronic exposure to TRI and PER was demonstrated. In addition, water was shown not to be the only path of entry to the human body for TRI and PER. While intake by water affected only a part of the population, exposure to contaminated air represented a far greater exposure risk. (Baker-FRC) W81-03887

SUBCHRONIC STUDY OF A MIXTURE OF IN-ORGANIC SUBSTANCES PRESENT IN THE GREAT LAKES ECOSYSTEM IN MALE AND FEMALE RATS,

Environmental Health Directorate, Ottawa (Ontario). Environmental and Occupational Toxicology Div.

I. Chu, D. C. Villeneuve, G. C. Becking, and R. Lough.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 42-45, 1981. 1 Tab, 3

Descriptors: Lakes, \*Inorganic compounds, \*Heavy metals, \*Great Lakes, \*Ecosystems, Arsenic, Cadmium, Laboratory animals, Chromium, Copper, Iron, Lead, Mercury, Nickel, Selenium, Zinc, Fluoride, Ecological effects.

The toxic effects were investigated of a combination of inorganic substances when administered to the rat at levels equal to or greater than the objectives established in the Great Lakes Water Quality Agreement of 1978. The substances placed into the drinking water of these rats included arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, zinc, and fluoride. Treatment lasted 13 weeks. No spontaneous deaths occurred. Clinical signs of toxicity were not noted. Food consumption and weight gain were unaffected. Fluid intake was not diminished. Weights of the adrenals, heart, liver, lungs, ovaries, testes, pituitary, prostate, uterus, spleen, thyroid and brain were not significantly different from controls. Fasting glucose, BUN, total bilirubin, cholesterol, total protein, alkaline phosphatase, albumin, globulin, albumin/globulin ratio, SGOT, SGPT, sodium, potassium, calcium and phosphorus levels were unchanged. All hematological parameters were normal. Thus it was concluded that no deleterious

#### Waste Treatment Processes—Group 5D

effects occurred in rats fed a mixture of the above chemicals for 90 days in their drinking water. (Baker-FRC) W81-03892

RELATIONS BETWEEN THE DECLINE OF THE FRESHWATER PEARL MUSSEL (MAR-GARITIFERA MARGARITIFERA) IN THE FICHTELGEBIRGE AND THE WATER QUAL-ITY. (ZUSAMMENHANGE ZWISCHEN DEM BESTANDSRUCKGANG DER FLUSSPERL-MUSCHEL (MARGARITIFERA MARGARITI-FERA) IM FICHTELGEBIRGE UND DER CEWASEERDELASTING GEWASSERBELASTUNG), Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer

Tierokologie.
G. Bauer, E. Schrimpff, W. Thomas, and R.

Herrmann. Archiv fur Hydrobiologie, Vol 88, No 4, p 505-513, June, 1980. 3 Tab, 14 Ref.

\*Water pollution effects, \*Trace elements, Eutro-phication, Streams, Sediments, Trace metals, Popu-lation dynamics. \*Metals.

Trace metals and nutrients were measured at 55 Trace metals and nutrients were measured at 55 sampling points in 10 flowing streams and their sediments in May 1978 to determine the factors inhibiting the reproduction of the freshwater pearl mussel in Central Europe. Multivariate statistical methods were used to determine the factors that can be used to discriminate between the rivers with young mussels, those with no reproduction of mus-sels, and rivers where all mussels have died out. The nutrients phosphate and calcium were found to be of great importance, particularly in rivers with low calcium content, where they determine the amount of organic production. The pH in flowing water, Cr in sediments and the electrolytic conductivity in both also had an effect, but the other variables studied were unimportant. Measother variables studied were unimportant. Measurements were made using potentiometry, atomic absorption spectrophotometry and inverse voltammetry. Eutrophication, which alters the sediment, is probably the main cause of the extinction of the freshwater pearl mussel. Pollution seems to be of less importance. (Hertzoff-FRC) W81-03903

WASTEWATER CHEMICAL AFFECTS PLANT

GROWTH,
Arizona Univ., Tucson. Coll. of Agriculture.
For primary bibliographic entry see Field 5A.
W81-03928

EPA PUTS EMERGENCY WATER PROVI-SIONS INTO ACTION, Environmental Protection Agency, Washington, DC. Office of Water Supply. J. F. Manwaring, L. A. Van Den Berg, and B.

ater and Wastes Engineering, Vol 17, No 4, p 40, 42-44, April, 1980.

Descriptors: \*Organic compounds, \*Carbon tetra-chloride, \*Environmental Protection Agency, Ohio River Basin, Chemical wastes, \*Water pollu-tion effects, Sampling, Monitoring, Rivers, Indus-trial wastes, Potable water, Water quality, Toxic-ity, Public health, Water pollution sources, Sol-vents, Regulations, Water pollution control, Case studies.

A case study describes the EPA's response to repeated carbon tetrachloride (CCl4) spills into the Ohio River Basin during 1975-1977. When the National Organics Monitoring Survey showed 10 ppb carbon tetrachloride in drinking water at Huntington, West Virginia, Section 308 inquiries were initiated. Three of the four companies involved cooperated, while the fourth refused self-sampling and analysis. On Feb. 9 Cincinnati tap water contained an exceedingly high level of CCl4, 80 ppb. Additional sample results indicated a 70 ton slug of Additional sample results indicated a 70 ton slug of solvent in the Ohio River. Increased river flow caused EPA computations of the slug's location to be in error; it had passed the cities several days earlier than expected. Additional spills were reported on Feb. 24 and March 9. Under the emer-

gency provisions of the SDWA and FWPCA, a restraining order was issued to control future discharges. The 70 ton slug and other spills cost government agencies \$356,940, and the public undetermined acute and long-term health problems. The EPA has taken measures to limit future discharge of CCl4 into these rivers. The experience of this spill has generated some ideas for preventing future crises: monitoring selected pollutants routnely, formalizing the guidelines for safe levels of various compounds in drinking water, coordinating emergency responses in the hands of one person, mobilizing laboratory facilities and toxicological advice, reviewing NPDES permits, developing a better predictive model for flow in the Ohio and Kanawha Rivers, and implementing a predetermined contingency plan. (Cassar-FRC) W81-03945 gency provisions of the SDWA and FWPCA, a

#### 5D. Waste Treatment Processes

BASIC POLICIES FOR SEWAGE WORKS IN

Ministry of Construction, Tokyo (Japan). Dept. of Sewerage and Sewage Purification.

S. Ionyama.

In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 5-35. 3 Fig, 4 Tab.

Descriptors: \*Sewer systems, \*Wastewater facili-ties, \*Wastewater disposal, \*Long-term planning, \*Short-term planning, Water quality standards, Rivers, Sludge disposal, Sludge utilization, Water pollution control, Water reuse, Flood control, Re-

Sewage installations in Japan are in the developing stage because the importance of sewerage service has not been fully recognized by the people and because urbanization was begun without provision because uroanization was begun without provision of sewer service. Sewerage services are available to only 27% of the population, but are being extended. Sewerage systems are being built as part of the national land policies of the government. In major urban areas river water quality has improved similfocatily once settings assetsme have proved significantly once sewage systems have been installed, although wide, closed-type water bodies have shown less improvement. Reuse of treated water and use of treated sewage sludge on the land are being encouraged as resource conser-vation measures. Long-term sewerage plans include: increasing the provision of sewerage servciude: increasing the provision of sewerage services; technical improvements in treatment; upgrading of existing facilities; treatment and use of sewage sludge; and reuse of treated water. Short-term plans include: acceleration of sewerage projects in small cities; flood control in urban areas; substitutement of treatments and treatment of treatments. achievement of water quality standards in the wide, close-type water bodies; entrophication prevention; and water quality conservation in tourist resort and rural areas. (Brambley-SRC) W81-03610

REGIONAL WASTEWATER TREATMENT PLANNING IN TOKYO BAY AREA, Ministry of Construction, Tokyo (Japan). Dept. of Sewerage and Sewage Purification. T. Tamaki.

T. Tamaki.

In: Proceedings; Seventh United States/Japan

Conference on Sewage Treatment Technology,
May 19-21, 1980, Tokyo, Japan. Environmental

Protection Agency Report EPA-600/9-80-047, December, 1980, p 57-88. 11 Fig. 8 Tab.

Descriptors: \*Wastewater treatment, \*Wastewater facilities, \*Sewage districts, \*Water pollution, \*Tokyo Bay, Chemical oxygen demand, Urbanization, Pollutants, Computer models, Water quality standards, Algal growth, Secondary wastewater treatment, Advanced wastewater treatment, Regional planning, Japan.

Nine major rivers flow into Tokyo Bay, which is surrounded by a basin which has 2% of the land area of Japan, 20% of the population and 22% of the industrial production. The area is becoming increasingly urbanized. There are 58 sewage treat-

ment plants, serving 9,000,000 people, 40% of the population of the basin. COD levels range from 2-6 mg/l at different areas of the bay, with the highest levels in the northwest. Pollutants enter the bay via levels in the northwest. Pollutants enter the bay via the rivers, other channels, and directly from sewage treatment plants. The COD load amounts to 440 ton/day, on a mean annual basis. Tidal current and water quality simulation models are available for the bay. As of 1975, environmental standards were met only 44% of the time. To achieve these standards the inflow COD must be reduced by 50% and the algal production 75%. Priority is placed on the construction of secondary. Priority is placed on the construction of secondary treatment facilities, but advanced wastewater treattreatment inclinies, our awareness wasteware treatment facilities are planned. These plans are being developed on a regional basis, because of the efficiences gained. The problems of securing adequate land for disposal and siting, consent of local inhabitants, and costs of transportation must be solved in each case. (Brambley-SRC) W81-03612

PUBLICLY OWNED TREATMENT WORKS PRETREATMENT CONTROL PRACTICE IN

Japan Sewage Works Bureau, Tokyo. T. Nonaka.

Nonaka.
 Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1930, Tokyo, Japan. Environmental Protection Agency Report EPA-60/9-80-047, De-cember, 1980, p 167-197. 7 Fig. 19 Tab, 1 Append.

Descriptors: \*Water pollution control, \*Industrial wastes, \*Wastewater treatment, \*Wastewater facilities, Effluent limitations, Water quality standards, Pollutants, Water reuse, Financing, Heavy metals, Cooperatives, \*Tokyo, Japan.

Effluent limitations are enforced in Tokyo by pros-Effluent limitations are enforced in Tokyo by pros-ecution of offenders, orders for facility improve-ment, suspension of discharging wastewater, or installation of a pretreatment facility. Factories are subject to surveillance visits, but are also able to obtain advice from the Publicly Owned Treatment Works system staff. The number of factories with pretreatment facilities is increasing, with slowest pretreatment facilities is increasing, with stowers progress shown by the smallest companies (fewer than 20 employees). Loans are available to finance pretreatment facilities. Violations of standards after installation of pretreatment facilities have been determined to be about half due to the pretreatment and half due to improper operation and mainte-nance of the facility. Recovered wastewater is reused by industries after further purifying. The priority pollutants are identified for the food processing, textile, metal products manufacturing, ma-chinery manufacturing, metal plating, plate making and painting, chemical, and ceramics industries, and nonindustrial concerns. A group of ten small metal plating industries set up a cooperative pre-treatment facility and a 1,100 member group of electroplating industries set up their own cyanide pretreatment facility. This process reduces cyanide to below the effluent standard, and the standards are also met for cadmium, copper, zinc, total iron, and total chromium. (Brambley-SRC) W81-03615

WATER QUALITY IMPROVEMENT IN YODO RIVER AND SEWAGE WORKS IN KYOTO, Japan Sewage Works Bureau, Tokyo.

T. Yoneda.

T. Yoneda.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 311-330. 18 Fig. 9 Tab.

Descriptors: \*Wastewater treatment, \*Water qual-Descriptors: "wastewater treatment, water quaity control, "Sewer systems, "Water pollution control, "Biological oxygen demand, Chemical oxygen demand, Pollutants, Water use, Water resources development, Wastewater facilities, "Kyoto,

The Yodo River and its tributaries flow through six prefectures and the city of Kyoto before dis-charging into the Seto Inland Sea. The catchment area is 7,281 sq km over half of which is that of Lake Biwa. Of the 10 billion cu m annual flow

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5D—Waste Treatment Processes**

11% is used for household, 4% for industrial, and 5% for agricultural purposes. Pollution of the Yodo River increased to a maximum in 1969 when BOD was 6.2 mg/l at Hirakata, declining to 3.2 mg/l in 1975. The total COD load entering the Seto Inland Sea is now strictly controlled, and attention is being paid to improving the sewage system of Kyoto as a major source of pollution. There were three sewage treatment plants in the city in April 1979, with three more planned, and with enlarged service areas planned for the existing plants. Rapid industrial growth and increased plants. Rapid industrial growth and increased water use per capita by a growing population have put additional burdens on the sewage treatment plats. As the treatment capacity has increased, the BOD of the effluent has declined, although river BOD levels have risen slightly, especially in low-flow years. Biological water quality in the Yodo River is considered to have improved; continued construction of sewage works in Kyoto and other cities of the basin are essential if these improve-ments are to be maintained. (Brambley-SRC) ments are a W81-03617

MUNICIPAL TREATMENT REQUIREMENTS AND PRACTICES TO MAINTAIN WATER QUALITY IN THE TAMPA AND ESCAMBIA

BAY AREAS, Florida State Dept. of Environmental Regulation, Tallahassee. Div. of Environmental Progra H. L. Rhodes.

H. L. Rhodes. In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, De-cember, 1980, p 365-451. 58 Fig, 2 Tab, 17 Ref.

Descriptors: \*Wastewater treatment, \*Water quality, \*Estuaries, \*Water pollution sources, Eutrophication, Dredging, Runoff, Industrial wastes, Nonpoint pollution sources, Tampa Bay, Escambia

Sewage treatment has been subjected to special requirements in two areas of Florida: Tampa and Escambia Bays. Special water quality problems and special events pushed these two areas toward treatment above secondary into advanced treat-ment for surface water dischargers. Due to constituency desires, numerous water quality problems and a common belief that secondary treatment was and a common order that secondary treatment was inadequate in the Tampa Bay system and other bays of west-central Florida, a bill was passed requiring Advanced Water Treatment (AWT) for municipal waste. The other special requirement came about as a result of massive fish kills in Escambia Bay in 1969-1971. Reviews of past data and regulatory schemes that led to upgrading sewage treatment works were made for compari-son purposes with the state of the environment today. As important as sewage discharges are to water quality in estuaries, problems were caused by other activities of man. These activities includ-ed industrial discharges, dredge and fill operations, and non-point source discharges. Each appears to have a synergistic effect on water quality in estimates. Escambia Bay is very slowly recovering from pollution of the 1960's. Tampa Bay is also showing marginal signs of improvement. Regulatory action in the municipal, industrial, dredge and the contraction of the con fill, and non-point source sectors have together begun to positively impact water quality in these systems. (Moore-SRC)

IMPACT OF INNOVATIVE AND ALTERNATIVE TECHNOLOGY IN THE UNITED STATES IN THE 1980'S,

Municipal Environmental Research Lab., Cincin-

Municipal Environmental Research Lab, Cincinnati, OH. Wastewater Research Div. J. M. Smith, J. J. McCarthy, and H. L. Longest, II. In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 515-577. 11 Fig. 18 Tab, 25 Ref.

Descriptors: \*Wastewater treatment, \*Wastewater facilities, \*Cost analysis, Biological treatment, Land disposal, Aquaculture, Sludge disposal, Industrial wastewater, Water pollution prevention,

Wastewater management, Wate Wastewater renovation, Construct Energy, Sludge digestion, Technology. Water reuse. Construction

Innovative and Alternative Technology is being applied to the design and construction of municipal wastewater treatment facilities in the United States wastewater treatment facilities in the United States in order to reduce costs, conserve energy, reduce pollution and increase wastewater recycling. An incentive to encourage Innovative and Alternative Technologies is an increase in federal construction grants from 75% to 85% using special set-aside funds. During the first 1 1/2 years, 273 facility plans have been received that include Innovative and Alternative Technology. Technologies being considered include: vertical well chemical reactor; improved searting efficiency and reliability; deep considered include: vertical well chemical reactor; improved aeration efficiency and reliability; deep well biological reactor; joint municipal and industrial waste treatment; fluidized bed biological treatment; land treatment of wastewater; municipal wastewater aquaculture; combined sludge/solid waste disposal and energy recovery system; and combined aerobic/anaerobic sludge digestion process. For fiscal years 1979 and 1980, 42.5% of the ess. For fiscal years 1979 and 1980, 42.3% of the construction grant projects are estimated to qualify for Innovative and Alternative Technologies, and 59.5% for fiscal year 1981. A total of \$84 million spent as Innovative and Alternative set-aside funds, which is equivalent to \$1.786 billion of construction grant funds, will result in \$498 million or 28% total construction grant savings. (Moore-SRC)

OCCURRENCE AND REMOVAL OF TOXICS IN MUNICIPAL WASTEWATER TREATMENT FACILITIES.

FACILITIES, Municipal Environmental Research Lab., Cincinniti, OH. Wastewater Research Lab.
J. J. Convery, J. M. Cohen, and D. F. Bishop.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 633-706. 6 Fig. 21 Tab, 23 Ref, 3 Append.

Descriptors: \*Water pollution sources, \*Wastewater treatment, \*Wastewater facilities, Industrial wastewater, Pollutants, Sludges, Metals, Municipal wastewater, Legislation, Effluents, Wastewater analysis, Toxins.

The need for data on the occurrence and removal of toxic substances in municipal wastewater treatment facilities is derived from the informational requirements of environmental legislation, the conment facilities is derived from the informational requirements of environmental legislation, the consent decree agreement and the implementation requirements of federal, state and local regulatory agencies. Pretreatment of industrial wastewaters for removal of metals significantly reduced the concentration of metals in the raw wastewater to a municipal plant. This effect is most evident in the reduction of metals in the sludges. Very early in the research, it became evident that analytical methods for the priority pollutants would have to be developed that were capable of qualitative and quantitative detection of these compounds at the parts-per-billion level in all types of wastewaters and sludges. This has been done, but it is clear that much more analytical methodology research will still be required. Surveys in three cities to assess the situation in the field on the occurrence and concentration of priority pollutants entering and leaving municipal treatment plants indicate that most of the priority pollutants (87 of 129) were detected in the influent but generally at low concentrations. Some thirty compounds were detected detected in the influent but generally at low con-centrations. Some thirty compounds were detected in effluent samples at or near the concentrations proposed for stream water quality criteria. While it can be expected that dilution in the surface waters will provide some margin for safety, these com-pounds may require some attention if other cities encounter higher influent concentrations. (Moore-SRC) W81-03623

IMPROVED OPERATION AND MAINTE-NANCE OPPORTUNITIES AT MUNICIPAL TREATMENT FACILITIES,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div. J. M. Smith, F. L. Evans, III, and J. H. Bender.

In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 731-775. 4 Fig, 16 Tab, 15 Ref.

Descriptors: \*Wastewater treatment, \*Wastewater facilities, \*Performance evaluation, \*Operating policies, Surveys, Municipal wastes, Water quality standards, Water pollution prevention

A vital component of the strategy to meet the National Water Quality Goals is to substantially improve the performance of publicly owned municipal treatment works through the integration of state and federally-issued permits, federal enforcement actions, and the federal Construction Grants ment actions, and the federal Construction Grants Program. Although federal and state governments subsidize from 75-98% of the capital costs of publicly owned municipal treatment facilities, the local government bears the responsibility for operation of these plants in accordance with NPDES permit requirements. Based on the results of a survey of publicly owned municipal treatment plants, the 10 highest ranking causes of poor plant performance result from inadequate plant operation and plant design deficiencies. Because there is an interrelationship hetween performance limiting factors and tionship between performance limiting factors and tionship between performance limiting factors and corrective programs, and because most existing correction programs focus on single problems only, a new approach which addresses all problems at a single facility was developed, called a Composite Correction Program (CCP). The purpose of the CCP is to eliminate all the performance limiting factors at a plant through the implementation of the corrective recommendations that are made as a part of the comprehensive evaluation. The CCP was successfully demonstrated at several facilities. In addition to providing an in-denth unfacilities. In addition to providing an in-depth un-derstanding of the major categories of problems affecting the performance of municipal treatment plants and the development of the CCP, the survey prants and the development of the CCP, the survey results have been the major influence in directing programs in plant operation and design. (Moore-SR) W81-03625

STATUS OF DEEP SHAFT WASTEWATER TREATMENT TECHNOLOGY IN NORTH

TREATMENT TECHNOLOGY IN NORTH AMERICA, Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div. R. C. Brenner, and J. J. Convery. In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 777-824. 10 Fig. 8 Tab, 25 Ref.

Descriptors: \*Wastewater treatment, \*Deep shaft process, Oxygen process, Aeration, Flotation, Sedimentation, Water quality standards, Oxygen demand, Costs.

The development of Deep Shaft technology is reviewed briefly, and initial results of an EPA demonstration project and the status of the technology are reported. The Deep Shaft reactor consists of a vertical shaft 130-150 m deep into which wastewater is continuously pumped. Compressed air is pumped into the downcomer and the riser to provide oxygen for treatment and maintain circulation. The liquid passes must be riser and some output. tion. The liquid passes up the riser and some over-flows into sedimentation or flotation tanks while the rest is recirculated. The initial design has been modified to increase aeration and circulation, and to improve the flotation process. Further advances in instrumentation and controls are under way. The EPA demonstration plant in Ithaca, New York, has a 136 m shaft, both flotation and gravity clarification capabilities, and a hydraulic capacity of 1325 cu m/day. During start-up, the plant reduced BOD and COD to EPA guideline levels in the effluent, but engineering and maintenance problems have caused breaks in operation. The Deep Shaft process differs significantly from conventional processes, not only in its vertical shaft and flotation of solids, but it does not require mixers to dissolve oxygen, the microorganisms in the biomass are subject to wide swings in hydro-static pressure, it has an ultra-high suspended growth process with low nominal detention times

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Waste Treatment Processes—Group 5D

and highly concentrated biomass, produces very high internal oxygen uptake rates, produces less sludge in a more concentrated form, and requires a larger air supply. Cost savings result from the reduced detention times and smaller land area required. Three Deep Shaft plants are starting-up in Canada and seven are operating in Europe, with a total of seven in the planning or building stages. (Brambley-SRC) W81-03626

#### CURRENT DESIGN AND OPERATING EXPERIENCE WITH ANAEROBIC SLUDGE DIGES-TION.

Los Angeles County Sanitation Districts, Whittier,

For primary bibliographic entry see Field 5E. W81-03627

#### EFFECT OF SANITARY LANDFILL LEA-CHATE ON THE ACTIVATED SLUDGE PROC-ESS.

Environmental Protection Agency, Cincinnati,

M. D. Cummins.

Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: A12 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Pro-ceedings of the Seventh Annual Research Sympo-sium, March 16-18, 1981, Philadelphia, Pennsylva-nia. Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 170-178. 6 Fig, 1 Tab, 3 Ref

Descriptors: \*Leachates, \*Activated sludge process, \*Wastewater treatment, \*Simulation, Chemical oxygen demand, Sludge volume index, Bacteria, Growth, Landfills, Water pollution prevention.

Synthetic sanitary landfill leachate was spiked sequentially at COD levels of 100, 200, and 400 mg/l into a conventionally designed activated sludge wastewater treatment plant, and the process control problems evaluated. The leachate simulated the high organic strength leachate produced by a young landfill. The specific oxygen utilization rate in the spike system and control system generally paralleled each other with the exception of an increase in the spike system following addition of the leachate. The sludge volume index increased after the first leachate, then declined with the subsequent additions, but during the 400 mg/l COD period the mass of bacteria increased uncontrollably and filled the clarifier. The oxygen demand with 400 mg/l COD was 75 mg oxygen/h compared with 38 mg oxygen/h for the control. The activated sludge process was able to treat a The activated sludge process was able to treat a synthetic leachate with COD of up to 200 mg/l but at 400 mg/l the increase in sludge mass and degra-dation in sludge settling characteristics resulted in the sludge volume overloading the clarifier.
(Brambley-SRC)
W81-03639

#### PROCESSES AND APPARATUS FOR REMOVING SUSPENDED MATTER FROM SUSPENSIONS BY FILTRATION THROUGH FOAMS, BASF, Ludwigshafen am Rhein (Germany, F.R.)

(Assignee). H. Daucher, M. Dressel, K. Hess, and H.

H. Daucner, M. Engelhardt.
U.S. Patent No 4,212,737, 8 p. 4 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 1006, July 15, 1980.

Descriptors: \*Patents, \*Water treatment, \*Wastewater treatment, \*Separation techniques, Suspended solids, Filtration, Foaming, Foam separation, Filtration, Equipment.

A process and apparatus for removing suspended matter from suspensions by filtering through foams is described. The suspended matter retained in the foam (polyurethane foam produced by foaming with water vapor being preferred) is substantially flushed out by expressing the liquid held in the foam, and is removed as a concentrate. This for the first time permits the removal of suspended matter from continuously flowing suspensions without the

flow of the suspensions having to be interrupted in order to clean the filtering means. (Sinha-OEIS) W81-03670

#### RAW LIQUID WASTE TREATMENT PROC-

ESS, California Inst. of Tech. Pasadena, CA. (Assignee). J. C. Fletcher, and M. F. Humphrey. U.S. Patent No 4,212,732, 9 p. 3 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 1004-1005, July 15, 1980.

Descriptors: \*Patents, \*Wastewater treatment, Sewage treatment, \*Water pollution treatment, Organic wastes, Separation techniques, Activated carbon, Absorption, Pyrolysis, Ash material.

A raw sewage treatment process is disclosed in which substantially all the non-dissolved matter, which is suspended in the sewage water is first separated from the water, in which at least organic matter is dissolved. The non-dissolved material is pyrolyzed to form an activated carbon and ash material without the addition of any conditioning agents. The activated carbon and ash material is added to the water from which the non-dissolved matter was removed. The activated carbon and selections and selections are moved. matter was removed. The activated carbon and ash material absorbs organic matter and heavy metal ions, it is believed, are dissolved in the water and is ions, it is believed, are dissolved in the water and is thereafter supplied in a counter current flow direc-tion and combined with the incoming raw sewage to facilitate the separation of the non-dissolved settleable materials from the sewage water. The used carbon and ash material together with the non-dissolved matter which was separated from the sewage water are pyrolyzed to form the acti-vated carbon and ash material. (Sinha-OEIS)

#### MEANS FOR BIOLOGICAL TREATMENT OF

WATER, V. N. Etlin.

U.S. Patent No 4,211,657, 7 p, 6 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 996, No 2, p 624, July 8, 1980.

Descriptors: \*Patents, \*Wastewater treatment, Sewage treatment, \*Aeration, Settling basins, Bubbles, Activated sludge, Circulation, Equipment.

Biological treatment of sewage is characterized in Biological treatment of sewage is characterized in the provision of a single aerating device feeding waste water serially into first and second settling chambers. The aerating chamber has a horizontal sectional area which generally increases in size from a relatively smaller horizontal sectional area at the bottom of a relatively larger horizontal section area at the top. The aeration chamber is characterized in the introduction of relatively large air bubbles within the water being aerated. The larger bubbles tend to move more quickly to the surface of the liquid, thereby increasing normal water movement and achieving more rapid oxidation. Plural settling chambers are connected by tion. Plural settling chambers are connected by passageways to the aeration chamber, and an aerator causes recirculation of activated sludge from both chambers through the passageways, thereby treating in succession and maintaining sludge loss in the effluent at a minimum. (Sinha-OEIS)

APPARATUS FOR AEROBIC TREATMENT OF CONTAMINATED LIQUID, R. C. Weber, and L. A. Weber. U.S. Patent No 4,211,654, 12 p, 14 Fig, 4 Ref. Official Gazette of the United States Patent Office, Vol 996, No 2, p 623, July 8, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Sewage treatment, \*Aeration, Filtration, Filters, Sand, Flow control, Aerobic conditions, Water purification, Equipment, Backwashing, Sensors.

A waste treatment apparatus is operated either by gravity or by positive displacement pump in which a variable inflow of contaminated liquid is aerated, a variable limits of containing the fliquid is acted, clarified, and filtered. The filtered liquid is used to backwash one of at least a pair of rapid sand filters, while the other rapid sand filter is being utilized. The alternating cycle of backwashing and filtering

by the respective rapid sand filters, all of which is integrated with overall filtering operation, insures that at least one filter is fully operative at any time. The apparatus is adapted for variable inflow and can adapt to such unfavorable exigencies as overtaxing inflow and clogging at the filter or at an earlier stage of contaminated liquid treatment. Sensors are located suitably throughout the apparatus to adjust the system. The apparatus is constructed from an elongated, curvilinear cross section pipe which is cut to length and compartmentalized interiorly for the various steps. (Sinha-OEIS) W81-03678

#### WATER RECLAMATION PROCESS,

R. C. Thomas. U.S. Patent No 4,211,650, 11 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 996, No 2, p 620-621, July 8, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Industrial wastes, Laundering, Flocculation, Suspended solids, Aeration, Filtration, Flow control, Water reuse.

Dirty process water from commercial laundry facilities is collected from a process unit and intro-duced into a raw water holding tank. Water from the tank is passed at a uniform rate through a flotation cell where solids are frothed by flocculation and aeration and removed. The flocculating agent is a short chain cationic polymer. The water agent is a snort chain cationic polymer. The water is then introduced into a treated water holding tank where it is withdrawn at a uniform rate and filtered to remove more solids. The filtered water is stored in a filtered water storage vessel for its use in the process facility. Heat exchange keeps the filtered water at required temperature. Water discharged from the system to a sanitary sewer may have various degrees of purity. (Sinha-OEIS) W81-03679

#### ANAEROBIC METHOD OF TREATING HIGH-STRENGTH WASTE-WATER,

A. A. Friedman, and S. J. Tait. U.S. Patent No 4,211,647, 6 p. 3 Fig. 7 Ref; Official Gazette of the United States Patent Office, Vol 996, No 2, p 620, July 8, 1980.

Descriptors: \*Patents, \*Wastewater treatment, Organic wastes, Anaerobic conditions, Microorganisms, \*Anaerobic digestion, Gases, Equipment.

A method for treating fluid containing anaerobically digestible nutrients and organic substrates is described. Individual anaerobic microorganisms are established upon rotatable discs mounted within an enclosed housing and a stream of treata-ble fluid is passed through the housing to wet more than fifty percent of the disc surfaces. The discs are rotated through the fluid so that the microorare rotated infought for fluid so that the microor-ganisms are able to feed upon the nutrients and substrates in the fluid and expel a process gas into the atmosphere maintained over the fluid. To fur-ther enhance both the feeding of the microorgan-isms and the expulsion of gas, the housing is divid-ed into a number of individual compartments or stages and the pressure is reduced below atmos-pheric pressure in each compartment. (Sinha-OEIS) W81-03681

#### WASTE WATER PROCESS

Texaco Inc., White Plains, NY. (Assignee). C. W. Westbrook, L. J. Parcell, G. L. Claytor, and C. W. Westolick, S. J. L. B. V. Klock.
U.S. Patent No 4,211,646, 6 p. 9 Ref; Official Gazette of the United States Patent Office, Vol 996, No 2, p 619-620, July 8, 1980.

Descriptors: \*Patents, \*Wastewater treatment. Descriptors: "Fatents, "wastewater treatment, "Muster pollution treatment, "Industrial wastes, Toxicity, Corrosion, Separation techniques, Chemical reactions, Chemical precipitation, Hydrogen ion concentration, Cyanides.

A waste water stream characterized by having A waste water stream characterized by naving toxic and corrosive properties due to the presence of a cyanides formates and a halide of a metal or ammonia is treated by adding a ferrous ion to the

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5D—Waste Treatment Processes**

waste water to convert the cyanides to iron cyanides. A base is added until the pH of the waste water is adjusted to the range from about 9 to 11 to water stream is recovered. (Sinha-OEIS)

PROCESS OF WATER RECOVERY AND RE-MOVAL, H. F. Rothschild

U.S. Patent No 4,209,364, 8 p, 3 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 995, No 4, p 1383-1384, June 24, 1980.

Descriptors: \*Patents, \*Water treatment, \*Wastewater treatment, \*Water reuse, Industrial water, Desalination, Absorption, Evaporation, Condensation, Vapor pressure, Solar radiation,

Recovery of substantially pure water for reuse from waste feed solutions, saline solutions, etc. is carried out at considerably lower capital and/or operating costs using a modified absorption cycle. The process is carried out under vacuum so that relatively low temperature heat sources can be used to evaporate water as well as high temperaused to evaporate water as wen as high tempera-ture sources. The system comprises an evaporator, an absorber, a generator and condenser. A portion of the feed solution entering the evaporator vaporizes due to its latent heat and the vacuum of the system. The water vapor product is absorbed by an absorbent in the absorber The absorber solution is transferred to a higher pressure zone in the generator where the water held by the absorbent is vaporized. This vaporized water is condensed for recovery. A heat transfer medium is applied to each stage to either apply or remove heat as appropriate. (Sinha-OEIS)
W81-03684

ANAEROBIC DIGESTION PROCESS.

ANAEROBIC DIGESTION PROCESS, Agency of Industrial Science and Technology, Tokyo (Japan). (Assignee). M. Ishida, R. Haga, and Y. Odawara. U.S. Patent No 4,213,857, 8 p. 2 Fig, 2 Tab, 6 Ref; Official Gazette of the United States Patent Office, Vol 996, No 4, p 1397, July 22, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Water pollution treatment, Organic wastes, \*An-acrobic digestion, Degradation, Separation tech-niques, Water reuse, Methane.

The invention relates to a process for digestion treatment of organic wastes that are difficult to digest, with a high efficiency and an improved recovery rate of methane. The wastes, before subjected to anaerobic treatment, are heated at 55C-75C within an acid or alkaline solution for dissolving digestible ingredients and the insoluble ingredients ents are eliminated before being transferred to an anaerobic digestion step. By exercising a pre-treat-ment for dissolving and separating digestible ingre-dients, the size of the container will be minimized dents, the size of the Container will be limiting as a result of the shortened time required for digestion and the recovery rate of methane will be improved. (Sinha-OEIS)
W81-03687

FLOW-THROUGH COALESCING SEPARA-

Marine Construction and Design Co., Seattle, WA (Assignee).

(Assignee). J. W. Anderson. U.S. Patent No. 4,213,863, 13 p, 5 Fig, 15 Ref; Official Gazette of the United States Patent Office, Vol 996, No. 4, p 1399, July 22, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Oil pollution, \*Separation techniques, Filtration, Flow control, Flow resistance, Pressure, Pistons, Oil fields, Equipment, Backwashing.

A flow-through coalescing separator is applicable to clean immiscible liquids and to dirt-carrying immiscible liquies, such as dirty oil and water

mixtures. A normally retracted piston periodically backwashes and compresses the filter body in a pressure vessel so as to purge the filter body of accumulations of dirt and hydrocarbons. When the piston is being retracted by restoration of input liquid flow pressure, positive coupling of the piston to the filter body stretches it back to its original length and to the full functioning open-pore condition despite wall friction and limited rebound capa-bility of the filter body material. The system lends itself to manually controlled operation and to auto-matically controlled operation, either in the continuous flow-through mode or in the more frequently interrupted retention flow-through mode. quenty interrupted retention flow-intogin mode. In either mode the system provides predictably-metered backwash liquid volume determined by pressure vessel capacity from its input chamber to the working face of the piston. (Sinha-OEIS) W81-03688

COMBINATION OF A BIOLOGICAL DRY TOILET AND A BIOLOGICAL WASTE WATER PURIFYING PLANT, ASKO-UPO Oy, Lahti (Finland). (Assignee): and AGA Heating A.B., Gotenberg (Sweden). (Assign-

A. Asikainen. U.S. Patent No 4,213,864, 4 p, 2 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 996, No 4, p 1399, July 22, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Water pollution treatment, \*Domestic wastes, Water purification, Biological treatment, Settling basins, Filtration, \*Dry toilets.

A combination of a biological dry toilet and a biological waste water purifying plant comprises a tank for composting waste, a means for change of air in the tank, and a sludge sedimentation tank. A biofilter is provided through which the water to be purified is circulated. The combination comprises in addition a means for change of air in the biofilter, for circulating the water to be purified in the biofilter, for removing the purified water from the sludge sedimentation tank, for removing the sludge from the lower part of the sedimentation tank, for feeding the water to be purified through the dry toilet, and for mechanically purifying the water in the dry toilet. An equalizing basin is included in the waste water purifying plant, the dry toilet being at least partly submerged in the basin. being at leas (Sinha-OEIS) W81-03689

APPARATUS FOR SEPARATING SLUDGE, OIL AND THE LIKE FROM CONTAMINATED WATER,

Fabrication Unlimited, Inc., Houston, TX. (Assign-

U.S. Patent No 4,213,865, 5 p, 3 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 996, No 4, p 1399-1400, July 22, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Water pollution treatment, \*Separation techniques, Oil pollution, Oily water, Sludge, Flow, Flow separation, Equipment.

An apparatus for separating sludge, oil and the like from contaminated water has walls separating a tank into first and second compartments. The tank has an inlet for contaminated water, a first outlet for removing separated oil, a second outlet for removing the treated water and an outlet for removing separated sludge. A plate pack is mounted on an inclined wall within the tank with the pack sloping downwardly from a first to a second end.

The pack includes side walls, a top and a bottom forming a conduit for carrying the contaminated water from the first to the second end. Plates are mounted one above the other extending between the side walls to provide a plurality of passageways. The plate pack second end defines a substanways. The place second clid defines a substantially vertical plane when the pack is mounted on the inclined wall. The contaminated water passes from the first to the second compartment by flowing down through the passageways and the oil separates from the water during such passage to rise and flow out the first end and the sludge

separates from the water to settle and flow out the second end. (Sinha-OEIS) W81-03690

SEWAGE AND WASTE WATER TREATMENT, Ozodyne, Inc., San Diego, CA. (Assignee). A. van Gelder. U.S. Patent No 4,214,887, 12 p, 4 Fig, 12 Ref; Official Gazette of the United States Patent Office, Vol 996, No 5, p 1763, July 29, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Sewage treatment, \*Biological treatment, Oxidation, Filtration, Suspended solids, Ozone, Fertilizers, Sewage sludge.

The sediments and suspended solids to 20 microns or less are removed immediately and continuously from the in-flow, and the almost suspended solid-free flow is treated with ozone so as to react chemically with the dissolved and remaining suschemically with the dissolved and remaining sus-pended solids by oxidation to produce precipita-tions, gasifications and sterilization which in turn are removed immediately and continuously to 5 microns or less, thus greatly reducing the ozone requirements for the oxidation reactions. The liquid effluent discharged from this process is a clear and sterilized liquid having no contaminants harmful to biological life. The process also in-cludes the treatment of the removed solids from cludes the treatment of the removed solids from sewage with ozone to produce a completely deodorized and sterile product without the requirement of substantial chemical oxidation reactions, thereby reducing the ozone demand, and further treatment of the solids in such a manner so as to produce useful dry commercial fertilizers containing a maximum amount of non-pathogenic soil microorganisms required to sustain plant life. The steps are performed largely by existing equipment of proven ability with a minimum of moving parts. The ozone treating method can be applied to liqor proven ability with a minimum of moving parts. The ozone treating method can be applied to liquids and liquids containing a substantial amount of suspended solids in comparatively large and varied particulated sizes. (Sinha-OEIS) W81-03693

TWO STAGE WASTEWATER FLOTATION, Dravo Corp., Pittsburgh, PA. (Assignee). O. A. Clemens. U.S. Patent No 4,214,987, 11 p, 4 Fig, 1 Tab, 6 Ref; Official Gazette of the United States Patent Office, Vol 996, No 5, p 1790-1791, July 29, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Separation techniques, Foam separation, Foaming, Buoyancy, Flocculation, Coagulation, Bubbles, \*Flotation, Product recovery.

In a first stage, a flow of wastewater is adjusted to near zero streaming potential by injecting a mineral acid into the wastewater. This adjusted flow enters a basin where it is subjected to a decreasing gradient of small bubbles to form and separate off a first buoyant floe from the flow of wastewater. The flow of wastewater then passes to a second stage where a metal coagulant is injected. The wastewater and coagulant enter a coagulation cell into which dense quantites of bubbles are supplied. Buoyant composites of particulates, coagulant and bubbles are formed in the cell. These composites leave the cell together with the wastewater flow and enter a second flotation basin where a second buoyant floc is separated off. The first and second buoyant noc is separated out. The first and second floc combined have a higher solids content, have a lesser relative volume, and have physical proper-ties such that valuable materials are more readily recovered than from a floc that would be formed if the wastewater were subjected to the second stage only. (Sinha-OEIS) W81-03695

METHOD FOR TREATING WASTE WATER CONTAINING ORGANIC CONTAMINANTS UTILIZING A MAGNESIA ADSORBENT,

UTILIZING A MAGNESIA ADSORBENT, Agency of Industrial Science and Technology, Tokyo (Japan). (Assignee); and Hikkaido Soda Co., Ltd. (Japan). (Assignee). and T. Ohkuma. U.S. Patent No 4,216,084, 6 p. 2 Fig. 5 Tab, 6 Ref. Official Gazette of the United States Patent Office, Vol 997, No 1, p 218, August 5, 1980.

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Waste Treatment Processes—Group 5D

Descriptors: \*Patents, \*Wastewater treatment, \*Water pollution treatment, Organic wastes, Industrial wastes, Adsorption, Magnesium compounds, Regeneration.

An object of this invention is to provide a method utilizing a magnesia adsorbent which is easily regenerated and showing excellent adsorption properties as compared with conventional magnesia adsorbents. This object is achieved by using magnesia particles obtained by calcining magnesia properties are composition, at a temperature of 500C-700C. The magnesia adsorbent thus obtained has higher adsorption properties and after adsorption treatment, the adsorption properties are easily tion treatment, the adsorption properties are easily recovered by calcining at the above temperatures. Some kinds of metal oxides show extending effects without lowering the adsorption properties of the magnesia adsorbent and, instead, some of them can improve the adsorption properties. (Sinha-OEIS) W81-03702

FLOTATION METHOD AND APPARATUS, Iowa Beef Processors, Inc., Dakota City, NE. (As-

J. A. Chittenden.
U.S. Patent No. 4,216,085, 5 p. 3 Fig. 15 Ref;
Official Gazette of the United States Patent Office,
Vol 997, No. 1, p. 218, August 5, 1980.

Descriptors: \*Patents, \*Wastewater treatment, \*Water pollution treatment, \*Separation techniques, Turbulence, Aeration, Bubbles, Foam sepa-Suspended solids, Food processing industry, Equipment

Aerated liquid injected into contaminated wastewater provides minute bubbles which ascend slowly and become attached to contaminants to buoy them to the liquid surface. To produce an intimate mix of the aerated liquid and wastewater, the aerated liquid is injected into the wastewater the aerated liquid is injected into the wastewater through opposed mutually confronting openings. Streams emerging from the openings collide to create an area of high turbulence. The invention is particularly well suited to removing grease particles and other suspended solids from packinghouse effluent. (Sinha-OEIS) W81-03703

MULTI-STAGE SYSTEMS FOR WASTE WATER OXIDATION, Houdaille Industries, Inc., Fort Lauderdale, FL. WASTE

(Assignee).
M. G. Mandt.
U.S. Patent No 4,206,047, 12 p, 4 Fig, 5 Ref;
Official Gazette of the United States Patent Office,
VOl 995, No 1, p 226, June 3, 1980.

Descriptors: \*Patents, \*Waste water treatment, \*Water pollution treatment, Sewage treatment, Activated sludge, \*Oxidation, Oxygen, Aerobic conditions, Mixing.

An aerobic activated sludge treatment system for waste water such as sewage is described. Aeration systems include aeration basin means for aerobic activated-sludge treatment of sewage influent, comprising a staged plurality of complete-mix aer-ation tanks having different levels of treatment parameters. Further, a plurality of serially connected activated sludge aeration zones is desirably provided each of which utilizes air as the oxygen source, and a final aeration activated sludge zone is provided which may utilize relatively pure oxygen (i.e., at least 80% and preferably at least 90% oxygen by volume) as an oxygen source. The oxidation is carried out in at least two treatment oxidation is carried out in at least two treatment zones. The initial zone provides conditions of high rate mixing and oxygenation with atmospheric oxygen, while the final zone provides conditions of low rate mixing and oxygenation with relatively pure oxygen, and relatively high dissolved oxygen content. (Sinha-OEIS)

CHARACTERIZATION OF AIR POLLUTANTS FROM AN ACTIVATED SLUDGE PROCESS, For primary bibliographic entry see Field 5B. W81-03757

RATE OF INTAKE AND STREAM ADVANCE FOR LIQUID DAIRY MANURE IN FURROWS, Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.

of Agricultura angular W. R. DeTar.
Transactions of the ASAE, Vol 23, No 5, p 1171-1177, October/November, 1980. 5 Fig. 3 Tab, 6

Descriptors: \*Animal wastes, \*Wastewater farming, Irrigation design, \*Dairy industry, Soil physical properties, Flow rates, Hydraulic conductivity, Wastewater treatment.

Basic design data are presented which are needed to determine the length of furrow to use for a given flow rate, manure concentration, and soil given flow rate, manure concentration, and sort type. Five different concentrations of very dilute dairy manure were run down 18 furrows in a sandy loam soil at rates of 200, 400, and 600 ml/ min. Intake rates were related to the total solids min. Intake rates were related to the total solids concentration of the liquid manure and the permeability of the soil. With increasing solids concentrations of liquid manure, a sandy soil developed flow characteristics which are normally associated with much heavier soils. Capillary forces developed where they normally did not exist, and hydraulic conductivity decreased. Equilibrium intake rate was significantly reduced with lower flow rates. This may be because the depth of the stream has more influence on flow through the soil when the only forces acting are due to gravity. The design procedure is presented for determining the proper furrow length and the time it will take the stream to reach the end of the furrow. (Small-FRC)

MANAGING ENERGY AT WATER-POLLU-TION-CONTROL FACILITIES, Metcalf and Eddy, Inc., Boston, MA.

A. Jacobs. Water and Sewage Works, Vol 127, No 8, p 28-31, 61-62, August, 1980. 8 Fig, 3 Tab.

Descriptors: \*Wastewater facilities, \*Energy loss, \*Wastewater treatment, Treatment facilities, Conservation. Fuel. Costs.

Changes in the relative costs of energy, labor, and materials have influenced the operating costs at wastewater facilities. The cost of energy often equals or exceeds that of labor. Reducing consumption and increasing recovery of waste heat will aid in conserving energy. Energy consumption can be reduced by increasing the power factor, reducing the peak utility-company electric demand, using energy-efficient equipment, reduc-ing incinerator-fuel consumption, and improving plant control and operational procedures. In selectplant control and operational procedures. In select-ing equipment one must consider variable speed drives, which now power many of the pumps at treatment stations and other pieces of equipment. In dealing with incinerator fuel consumption, a number of variables influence the amount of fuel used including moisture and volatile-solids content of the sludge and the quantity of excess air for combustion. Dewatering the sludge will make the process more energy efficient. Changes in the type of chemical-conditioning agent represent another area for significant energy saving. A minimum of excess air requirements will reduce the heat input needed to raise the temperature of the air. Plant control is also a significant factor to be considered in achieving fuel efficient operations. (Baker-FRC) W81-03775

INNOVATIVE OXIDATION TECHNOLOGY FOR WASTE PRETREATMENT, Enercol, Inc., Red Bank, NJ. S. A. Peterson, and N. S. Zaleiko. Water/Engineering and Management, Vol 128, No 2, p 32-36, February, 1981. 4 Fig. 5 Tab, 8 Ref.

Descriptors: \*Wastewater oxidation, \*Oxidation process, Oxidation, \*Wastewater treatment, Chemical reactions, Ultraviolet radiation, Cavita-tion, Ionization, Industrial wastes, Municipal wastewater.

A new treatment process, termed ZOP, utilizes many of the chemistries occurring in the atmos-

phere to reduce such chemically diverse organic phere to reduce such chemically diverse organic compounds as sludge and sugar wastes to their basic chemical constituents in a time period rang-ing from 3 to 30 minutes. The process combines the production of sudden vacuum in a controlled cavitation reaction chamber with application of an ultraviolet light of specific wave lengths to stimu-late rapid production of free radicals, particularly budyavid and provided radicals. These radicals raphydroxyl and peroxide radicals. These radicals participate in chain reactions which result in low energy requirements for virtual completion of re-action. Ultraviolet light may stimulate additional free radical oxidation when applied following cavi-tation. Since the ZOP process results in the chemitation. Since the ZOP process results in the chemical breakdown of oxygen-consuming material, many of the problems inherent in a biological treatment system are eliminated or substantially reduced. Under most circumstances, organic sludges are not produced. Testing done at a municipal wastewater treatment plant used the following treatment sequence: initial rough screening, a cavi-tation/oxidation loop for solids degeneration and initial oxidation, addition of a free radical initiator, supplementary cavitation exposure to ultraviolet light for a few minutes, and return of solids to the cavitation loop by means of a cyclone separator. Clarification occurred while the reaction was still continuing. This continuous flow method permits rapid and effective pretreatment of various organic and toxic industrial wastes. Finally, the system requires only 5 to 25% the space of conventional systems. (Carroll-FRC) W81-03794

VIRUS REMOVAL BY COAGULATION AND FLOCCULATION.

Brown and Root, Inc., Houston, TX. B. Malek, D. B. George, and D. S. Filip. Journal of the American Water Works Associ-ation, Vol 73, No 3, p 164-168, March, 1981. 8 Fig, 3 Tab, 23 Ref.

Descriptors: \*Flocculation, \*Coagulation, \*Vir-uses, \*Water treatment, Turbidity, Public health, Sedimentation, Chemical coagulation, Filtration, Performance evaluation, Alum, Polyelectrolytes, Electrolytes, Bacteriophage, Cations, Ions.

The increasing use of direct filtration systems by communities that treat relatively clear water has raised questions concerning the ability of coagula-tion and flocculation to achieve high removal effition and flocculation to achieve high removal efficiency for viruses contained in low turbidity water at low congulant dosages. The effectiveness of coagulation and flocculation for virus removal was investigated using a series of jar tests focusing on the effect of various doses of alum and cationic polyelectrolytes on the removal of MS2 bacteriophage contained in low turbidity water. Virus removal efficiency was found to be a function of dosage when alum was used. Alum was not effective in removing the bacteriophage over the range of doses from 5 to 10 millitrams per liter. A dosage tive in removing the bacteriophage over the range of doses from 5 to 10 milligrams per liter. A dosage of 50 milligrams per liter reduced the virus by 89%. The cationic polyelectrolyte, Nalco 8101, was the most promising coagulant tested, achieving a virus removal rate of 96% with a dosage of 2 milligrams per liter. The efficiency of virus removal. al by this coagulant was not affected by turbidity. al by this coagulant was not affected by turbulty. Three other cationic polyelectrolytes were also tested. Virus reduction rates for these coagulants ranged from 57% to 75% using a dosage of 2 milligrams per liter. Only one of these coagulants was affected by turbidity. Maximum virus removal occurred at the lowest dosage of cationic polyelectrolytes, with an increase in dosage resulting in with an increase in dosage resulting in virus restabilization. Virus removal was not enhanced by extending the length of the flocculation period. (Carroll-FRC) W81-03799

TREATMENT OF MOUNT ST. HELENS VOL-CANIC ASH SUSPENSIONS BY PLAIN SEDI-MENTATION, COAGULATION, AND FLOC-

CULATION,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.

aurnal of the American Water Works Association, Vol 73, No 3, p 160-164, March, 1981. 8 Fig. 6 Tab, 3 Ref.

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5D—Waste Treatment Processes**

Descriptors: \*Water treatment, \*Volcanoes, \*Suspended load, Coagulation, Sedimentation, Flocculation, Suspended solids, Chemical composition, Fluorides, Turbidity, Alkalinity, Acidity, Pullman, Washington, \*Mount Saint Helens, Alum, Settleable solids, Conductivity, Volcanic ash, Ash.

Ash from the 1980 eruptions of Mount St. Helens blanketed much of the Pacific Northwest, altering the quality of open raw water supplies through direct fallout and by dissolution of the ash from runoff water draining the affected area. A study was undertaken to determine the treatability of aqueous suspensions of the volcanic ash deposited in Pullman, Washington. The ash entering the water resulted in an increase in settleable solids, turbidity, conductivity, and fluoride ion concentra-tions. Treatability studies investigated removal of the ash by conventional sedimentation and by coagulation-flocculation using alum followed by set-tling. These studies utilized ash suspensions at two alkalinity concentrations and at two volcanic ash levels. Sedimentation alone removed much of the ash as settleable solids when the ash was present in as as settleage some when the asi was present concentrations greater than 10 gallons per liter. The presence of bicarbonate ion enhanced the quantity of ash settling from the suspension. Simple sedimentation provides a simple method for reducing the ash content and tubidity of water contami-nated by volcanic ash. The presence of bicarbonate ion enhances the coagulation-flocculation of suspended ash particles by alum. The alum dose necessary to reduce turbidity is dependent on the initial concentration of ash in the settled suspension and the bicarbonate ion concentration. Alum also removed fluoride ion from solution. (Carroll-FRC) W81-03800

PRELIMINARY STUDIES ON THE USE OF INTERNAL CARBON SOURCES IN THE REMOVAL OF NITROGEN FROM SEWAGE WITH A MODEL TREATMENT SYSTEM USING ALTERNATING AEROBIC CONDITION AFRONDIC CONDITION AFRONDIC CONDITION AND ANALYSIS OF THE PROPERTY OF THE P AEROBIC CONDITIONS,
State Univ. of New York at Stony Brook. Dept. of

Biotechnology and Bioengineering, Vol 23, No 3, p 615-626, March, 1981. 1 Fig, 11 Ref.

Descriptors: \*Nitrogen removal, \*Carbon, \*Sewage treatment, Aerobic conditions, Anaerobic conditions, Nitrites, Ammonia.

A model wastewater treatment system was designed specifically with the physiological characteristics of nitrifying and dentirifying bacteria in mind. The criteria of the model were that domestic raw sewage be used as influent, no settling of raw sewage be allowed, total hydraulic retention times be 30-50 hr, alternating periods of aerobiosis and anaerobiosis be established, dissolved oxygen content not exceed 1 ppm, a sludge return of 1:1 be provided, and efforts be made to establish an infinite sludge retention time. The model demonstrated that nitrogen in domestic raw sewage could be reduced to 0 ppm of ammonia and about 5 ppm of nitrate nitrogen using only internal carbon sources.
(Baker-FRC) W81-03807

RECLAMATION PLANT DESIGN HONORED.

Journal of the American Water Works Association, Vol 73, No 3, p 26-28, March, 1981.

Descriptors: \*Wastewater facilities, \*Water reuse, \*Wastewater treatment, Wastewater renovation, Drinking water, Potable water, Water pollution control, Effluents, Virginia, \*Upper Occoquan Sewage Authority.

The advanced wastewater treatment plant operated by the Upper Occoquan Sewage Authority (UOSA) in northern Virginia has received the Consulting Engineers Council Honor Award after being judged one of the top fifteen engineering projects in the country. The UOSA plant has reduced pollution and has resulted in a new water resource for the area by incorporating state-of-the-resource for the area by incorporating state-of-theresource for the area by incorporating state-of-the-art processes to treat wastewater to meet treatment

standards so stringent that the effluent can be discharged to a drinking water supply. The new facility, which replaced eleven existing secondary treatment plants, incorporates extensive redundant electrical-mechanical features to ensure continuous operation and treatment and consistent production of an effluent of near drinking water quality. Plant treatment process byproducts are also recovered and recycled. Innovations at the plant include the new way of assembling existing wastewater treatment, and development of new technology to enable the plant to reclaim wastewater. (Carroll-FRC) W81-03817

EFFICIENCY OF NITROGEN REMOVAL IN A SIMULATED OVERLAND FLOW WASTE WATER TREATMENT SYSTEM, Army Engineers Waterways Experimental Station, Vicksburg, MS. Environmental Lab. R. L. Chen, and W. H. Patrick, Jr. Journal of Environmental Quality, Vol 10, No 1, p 98-103, January/March, 1981. 1 Fig, 8 Tab, 18 Ref.

Descriptors: \*Wastewater treatment, \*Denitrifica-tion, \*Overland flow, Flow, Simulation, Model studies, Wastewater oxidation, \*Nitrogen removal,

Nitrogen, Land disposal.

N-15 labeled ammonium sulfate was applied to scale models of plant-soil systems to determine the fate of waste water N applied to an overland flow system. The findings indicated that both nitrification and denitrification and/or assimilatory nitrate reduction occurred simultaneously in the overland flow system under laboratory conditions. Both oxi-dized and reduced zones existed in the soil models. The applied NH4-N was nitrified to NO3-N in the constantly oxidized surface soil, then moved down to the anaerobic bottom soil. At this point either denitrification or assimilatory nitrate reduction reactions proceeded. The overland flow model was able to remove about 80-90% of the added NH4+ -N within the N concentration range of 10-50 mg/ liter commonly found in lagoon or municipal treat-ed waste waters. The estimated N balance indicat-ed that the amount of N removed, including removal of N by plant uptake, was about 74% of the applied N. It is suggested that overland flow waste applied N. It's suggested that overland flow waster water treatment systems would be a practical method for effectively removing N from waste waters for small communities. (Baker-FRC) W81-03831

KINETICS AND STOICHIOMETRY OF RESPIRATION IN BIOLOGICAL TREATMENT PROCESS,

Stevens Inst. of Tech., Hoboken, NJ. L. K. Wang, J. Bergenthal, and M. H. Wang. Journal of Environmental Sciences, Vol 24, No 1, p 39-43, January/February, 1981. 52 Ref.

Descriptors: \*Activated sludge, \*Sludge treatment, \*Respiration, Kinetics, Nitrification, Oxygen re-quirements, Pilot plants, Pretoria, South Africa, Biological treatment, \*Biological wastewater treat-

Biological nitrification-dentrification is reviewed, with emphasis on the mechanisms and develop-ment stages of the process. Endogenous oxygen respiration and the endogenous nitrate respiration activated sludge are specifically studied. Within the realm of practical experience, the amount and types of endogenous substrates in activated sludge are sufficient for the reduction of all nitrate and nitrite in a typical mixed liquor. The operations of a pilot plant in Pretoria, South Africa, and a similar a pilot plant in the Netherlands are briefly noted. The South African plant was originally designed to treat 100 cubic meters/day. The MLSS (mixed liquor suspended solids) concentration was 4000 to fliquor suspendeu sonus; concentration was most of 6000 mg/l, and the sludge retention time was 16 to 18 days. Batch samples from the anoxic basin where endogenous nitrate respiration occurred were dosed with nitrate and tested for their respiration rates. A denitrification rate of 1.3 mg ni-trate-nitrogen/g SS/hour was found at 20 degrees. The reaction was zero order with respect to ni-trate-N. (Baker-FRC)

NITRIFICATION AND DENITRIFICATION OF AN INDUSTRIAL WASTEWATER.

Dorr-Oliver, Inc., Stamford, CT.
P. M. Sutton, T. R. Bridle, W. K. Bedford, and J. Arnold.

Arnold. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 176-184, February, 1981. 13 Fig, 2 Tab, 11 Ref.

Descriptors: \*Nitrification, \*Activated carbon, \*Temperature, Waste water treatment, Denitrification, Biological treatment, Organic wastes, Activated sludge, Oxidation, \*Industrial wastewater, Canada.

A two year study was conducted by DuPont of Canada Limited and the Waste Water Technology Center of Burlington, Ontario, to define the condi-Center of Burington, Ontano, to define the condi-tions needed for nitrification using the Maitland Works process configuration and to assess the ca-pability of the existing full-scale system. Bench-scale experiments showed that the performance of the DuPont process configuration was better than that of the two-stage separate sludge system. With the addition of powdered activated carbon, only a slight reduction in effluent filterable organic carbon occurred. At aerobic basin temperatures of 10 degrees, autotrophic nitrifiers demonstrated less to degrees, autotrophic intillers demonstrated less tolerance for changes in influent composition and temperature than did heterotrophic organisms in-volved in organic carbon oxidation and denitrificavolved in organic carbon oxidation and denitrifica-tion. DuPont of Canada will probably experience problems with winter nitrification until process changes are completed to raise the minimum winter aerobic basin temperatures. Full scale trials with nitrification-denitrification have illustrated the feasibility of biological nitrogen removal as an economical treatment method for complex wastes. (Geiger-FRC) W81-03851

METRO CHICAGO'S STUDY OF ENERGY AL-TERNATIVES FOR WASTEWATER TREAT-

Metropolitan Sanitary District of Greater Chicago,

H. H. McMillan, R. R. Rimkus, and F. C. Neil. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 155-161, February, 1981. 2 Fig, 6 Tab.

Descriptors: \*Waste water treatment, \*Cost analysis, Evaluation, Expenditures, \*Energy sources, Electric power costs, Operating costs, Sludge drying, \*Chicago, Economic aspects.

The Metropolitan Sanitary District of Greater Chi-The Metropolitan Sanitary District of Greater Chicago has recently conducted a critical review of its energy expenditures for waste water treatment. In view of rapidly rising costs and new national energy policies, alternate energy resources were explored. Producing heat for the boiler-steam turbines for the sludge drying system required a large energy input and constituted the greatest energy demand of the West-Southwest facility. Various energy alternatives were evaluated by examining annual costs, present worth, and primary energy requirements. It was concluded that the most cost-effective and energy efficient alternative would involve the replacement of the steam-driven turbines by electric motors driven by electricity pur-chased from a local utility. If this measure were to be implemented, the annual cost savings were esti-mated to be over \$5.8 million. (Geiger-FRC) W81-03852

INDUSTRIAL WASTE TREATMENT PLANT UPGRADES IN STEPS,

Catalytic, Inc., Philadelphia, PA. V. S. Wroniewicz, Jr. Water and Wastes Engineering, Vol 17, No 5, p 70-72, May, 1980.

Descriptors: \*Industrial wastes, \*Chemical wastes, Organic compounds, Clarifiers, Aeration, Landfills, \*Wastewater treatment, \*Toms River Chemical Corporation, New Jersey, Waste disposal, Disposal, Leachates, Test wells.

The Toms River Chemical Corporation, New Jersey, is expanding its industrial waste treatment

# WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

## Waste Treatment Processes—Group 5D

system to process an average 7.5 mgd (peak 9.4 mgd). The present waste load of 4.5 mgd contains inorganic and organic compounds, average BOD5 600 mg per liter, pH 2, negligible suspended solids, 600 mg per liter, pH 2, negligible suspended solids, and sanitary wastes. The equalization basins will be expanded and relined. Neutralization capacity will be increased. Two secondary and one primary clarifier, two aeration basins for biological removal of organics, and an on-site dual-lined landfill will be added to the facility. (Cassar-FRC)

# WASTEWATER TREATMENT PLANT WORKS OVERTIME, Green (Howard R.) Co., Cedar Rapids, IA.

Water and Wastes Engineering, Vol 17, No 9, p 70-73, September, 1980. 2 Fig. 2 Tab.

Descriptors: \*Heavy metals, \*Industrial wastes, \*Chemical wastes, Domestic wastes, Waste water treatment, \*Amana, Iowa, Chromium, Metals, recommendations of the control of Zinc, Sewage, Effluents.

The Amana Refrigeration Incorporated, Middle Amana, Iowa, waste water treatment plant handles the factory's sanitary and industrial wastes and will soon begin treating domestic wastes from the nearby Village of Middle Amana. Waste streams are segregated into two categories: hexavalent chromium-containing wastes and acid/alkali zinc-containing wastes. After reducing the chromium to the trivalent state, this stream is blended with the acid/alkali waste. Metals are removed as insoluble metal hydroxides in a precipitation, filtration, and neutralization process at greater than 99% efficiency. Domestic wastes are handled separately by aerobic digestion. (Cassar-FRC) W81-03873

# HARNESS THE WIND FOR AERATION,

Freeman (Peter A.) Associates, Inc., Berlin, MD. P. A. Freeman. Water and Wastes Engineering, Vol 17, No 9, p 25, 26, 29, 56, September, 1980. 4 Fig, 1 Tab.

Descriptors: \*Aeration, \*Lagoons, \*Winds, Water circulation, Dissolved oxygen, Water quality, \*Wastewater treatment, Destratification, Canals, Sediments, Lakes, Reservoirs, Oxygen, Wind Energy Water Aeration and Circulation System.

Waste water lagoons may be efficiently aerated at low cost using the Wind Energy Water Aeration and Circulation (WEWAC) system. Surface water saturated with dissolved oxygen is continually cir-culated to the bottom, increasing the dissolved oxygen level of the mixture. The wind energy drive is a Savonius-type vertical axis wind turbine driving a large diameter water propeller. These units, able to turn at wind speeds as low as 1 mph, function successfully in areas where the average wind speed is as low as 4 mph. A cost comparison between a WEWAC unit and an equivalent elecbetween a WEWAC unit and an equivalent elec-tric unit shows nearly equal initial costs and much lower annual costs (\$182 vs. \$895). The aeration units have been used to improve water quality in canals. Other possible applications are aeration and destratification of fresh water lakes and reservoirs, presenting of expeculture people and inhibitions of inaeration of aquaculture ponds, and inhibition of ice formation in waterways. (Cassar-FRC) W81-03874

# MANAGEMENT CONTRACT HELPS WAUSAU

MANAGEMENT CUNTRAUT HELD 3 MAGGINED BACK TO NORMAL, Zimpro, Inc., Rothchild, WI. W. E. Holz, J. R. Leonhard, and S. J. Duebler. Water and Sewage Works, Vol 127, No 6, p 54-55, 90, 92, June, 1980. 1 Fig. 1 Tab.

Descriptors: \*Wastewater management, \*Treatment plants, \*Wastewater treatment, \*Wausau, Wisconsin, Management planning, Contract, Legal aspects, Effluents, Training, Personnel, Man-

The Wausau, Wisconsin plant is a 9.2 MGD primary and activated sludge treatment facility dating from the 1930s, but expanded in 1970. Sludge thermal conditioning (38 Gpm), filter pressing (4 ft

x 4 ft plates, 108.4 cu ft capacity), and landfilling are used for solids removal. Two tanks originally designed as anaerobic digesters hold the sludge. Influent wastewater flows average 4-6 MGD. Con-Influent wastewater flows average 4-6 MGD. Contributions from industry can push the influent BOD and suspended solids population equivalencies to as high as 90,000. Chlorinated effluent is discharged to the Wisconsin River. After the plant had been cited for discharge (excess suspended solids and BOD) violations, a management firm was called upon to evaluate the system. The firm traced the plant's effluent difficulties to a solids problem, aggravated by the condition of the two shudge directors damaged by freezing weather. sludge digesters, damaged by freezing weather, and to influent toxicity, largely caused by the absence of an industrial waste ordinance or moni-toring program. Plant staffing was also inadequate. Staffing was upgraded and proper training given to the employees. Several process-optimization steps and operational adjustments were made. A cationic polymer was selected for use in the final clarifiers to increase suspended solids removed. to increase suspended solids removals. Loading rates to the final clarifiers were adjusted for better flow distribution. A complete plant inventory was established for preventive maintenance. The use of a management services contract has been effective in returning the Wausau plant to effluent compliance. (Baker-FRC) W81-03877

# REMOVE HEAVY METALS TWO WAYS, New Jersey Inst. of Tech., Newark. Dept. of

Chemical Engineering.
G. Lewandowski, and M. F. Abd-El-Bary.
Water and Sewage Works, Vol 127, No 1, p 44-45,
January, 1980. 2 Tab, 15 Ref.

Descriptors: \*Heavy metals, \*Chemical precipita-tion, Industrial wastewater, \*Wastewater treat-ment, Combined treatment, Water reuse.

In order to develop widespread agricultural use of municipal sludge, heavy metals must be removed. This can be done at the municipal treatment plant. Physical-chemical means could be employed fol-Physical-chemical means could be employed tol-lowing primary settling, or the combined sludge could be treated before digestion. Biological flocs adsorb metals onto the floc surfaces, and metabolic processes may incorporate them into the intracellu-lar structure. Heavy metals can also be removed at the source. Activated carbon adsorption, adsorpthe source. Activated carona assorption, adsolp-tion on clay, ion exchange, cementation, and elec-trolysis can all be used. The most common tech-nique is chemical precipitation in the form of hy-droxide, carbonate, or sulfide. Capital and operating costs are lower when metals are removed at the source. Also, the potential for metals recovery and reuse should stimulate removal at the source. and reuse sho (Small-FRC) W81-03878

INFLUENCE OF AZO DYE ON SYNCHRO-NIZED CELLS OF BACILLUS SUBTILIS, Gifu Univ., (Japan). Dept. of Synthetic Chemistry. T. Ogawa, E. Idaka, and C. Yatome. Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 38-41, 1981. 4 Fig, 1 Tab, 10 Ref.

Descriptors: \*Dye industry wastes, \*Bacillus, \*Microbial degradation, Biodegradation, Sludge digestion, Dyes, Bacteria, Nitrogen.

The toxicity and biodegradability of dyes must be investigated, since biological treatment is widely used for purifying dye plant wastewaters. A study was made of steps leading to the inhibition of synchronized cells of Bacillus subtilis by azo dyes. Specific susceptibility to dyes and related compounds as a sole nitrogen source was also investi-gated. The response to various dyes indicated that inhibition occurred mainly when the B. subtilis cells were exposed during periods of cell division rather than cell growth. For this reason the DNA content in the cells incubated in a medium containing PAAB (para-amino-azobenzene) was determined. The synthesis of DNA was found to be inhibited by PAAB. The assimilative capability of dyes and related compounds was then investigated.
When the cells were incubated without a nitrogen source, cell proliferation did not occur. The

was concluded that PAAB is assimilated as a sole nitrogen source in the initial stages of incubation, although its assimilation is inferior to that of pepauthough its assimilation is interior to triat of per-tone-meat extract or ammonium sulfate. Dyes with primary amino groups could also be assimilated. However, heterocyclic compounds and azo com-pounds were not assimilated, at least in the initial stage of incubation. (Baker-FRC) W\$1-03889

MANCHESTER, CONNECTICUT'S INFORMA-TION COLLECTION AND MANAGEMENT SYSTEM FOR WASTEWATER TREATMENT, Metcalf and Eddy, Inc., Boston, MA. For primary bibliographic entry see Field 6A. W31-03890

# ACCLIMATION OF ACTIVATED SLUDGE TO

DYE, Gifu Univ. (Japan). Dept. of Synthetic Chemistry. T. Ogawa, E. Idaka, and C. Yatome. Bulletin of Environmental Contamination and Toxicology, Vol 26, No 1, p 31-37, 1981. 6 Fig, 1 Tab, 15 Ref.

Descriptors: \*Microbial degradation, \*Dye industry wastes, Dyes, Activated sludge, Sludge, Wastewater treatment, Water quality, Oxygen uptake, \*Gifu City, Japan.

The oxygen uptake rates of microbes acclimated through continuous culture in a medium containing through continuous culture in a medium containing dyes were obtained for the same and different kinds of coexisting dyes, and the influence of these dyes on the respiratory inhibition of the microbes was investigated. Return sludges from the North Treatment Plant of Gifu City, Japan were used as the microbial source. The plant uses the convenience of the plant uses the convenience of the plant to gifu City. tional activated sludge process, and wastewater from industry is not present to any great extent. The results indicated that the tolerance of the microbes to the dyes is transferable to the same series of dyes used for the acclimation but failed to display any adaptability to a different series of dyes. This suggests that in the practical treatment or the practical treatment of wastewater with microbes, the mixing of different kinds of dyes is the cause of the decline in the purification capability. (Baker-FRC) W31-03893

GAO SURVEY FINDS EXTENSIVE TREAT-MENT PLANT NONCOMPLIANCE, D. V. Feliciano. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 137-143, February, 1981. 4 Tab.

Descriptors: \*Evaluations, \*Wastewater facilities, Wastewater treatment, Standards, Guidelines, Water pollution control, Permits, Legal aspects, Local governments, Federal jurisdiction.

The General Accounting Office (GAO) was asked by the United States House Committee on Public Works and Transportation to investigate the performance of municipal wastewater treatment plants. The GAO used a three-pronged survey/analysis involving a review of 15 plants in eight states, monitoring for 1 year the discharge reports of 242 randomly selected plants, and examining the legislative documents and interviewing government officials, engineers, and professional organizations. GAO found that 87% of the 242 randomly selected plants were in violation of their National zations. GAO found that 87% of the 242 randomly selected plants were in violation of their National Pollutant Discharge Elimination System (NPDES) permits for at least 1 month/year. Fifty-six percent of the violating plants exceeded their NPDES discharge limits for more than half the year. GAO recommended the establishment of clearer lines of recommended the establishment of clearer lines of accountability within the construction grants program and intervention of Congress and the Environmental Protection Agency to decide on funding issues for plant renovations. The Water Pollution Control Federation is reviewing the GAO findings to make a final report to the Subcommittee on Oversight and Review for the subcommittee's hearings on municipal treatment plant non-compliance. (Geiger-FRC) W81-03895

NEW WATER REUSE SYSTEM STUDIED.

# Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

# **Group 5D—Waste Treatment Processes**

Water/Engineering and Management, Vol 128, No 1, p 74, January, 1981.

Descriptors: \*Water reuse, \*Systems engineering, Wastewater renovation, Reclaimed water, Activated carbon, \*Flotation, Separation techniques, Electrolysis, Disinfection, Chlorination.

A system using dissolved air flotation, foam separation, and an activated-carbon packed electrolyzer is described for the treatment of waste water to make it reusable. The activated-carbon packed electrolyzer (ACPE) is the heart of the new system electrolyzer (ACFE) is the heart of the new system and performs multifunctional treatment by taking advantage of the bipolar phenomenon which occurs when direct current flows between elec-trodes separated by carbon media. When the carbon is depolarized it causes electronic migration of organics to its surface. Oxygen is also concentrated at the pores, and some oxidation occurs, resulting in decomposition of the electrically miresulting in decomposition of the electrically migrated organics. A test of the system was made using sewage containing 100 mg/liter of NaCl to determine if the application of direct current would produce enough residual chlorine to disinfect. Results indicated that residual chlorine charged in direct proportion to the current efficiency and was only 15% at a chloride concentration of 85 mg/Liter. Problems encountered in using the system included clogging of the carbon by suspended solids, and the selective adsorption of foaming compounds which reversed oxidative decomposition. (Baker-FRC) W81-03900

WATER NEED FULFILLMENT CHANGING IN THE 80S, J. B. Hanlon

Water and Sewage Works, Vol 127, No 12, p 30, 45, 67, December, 1980.

Descriptors: \*Waste water treatment, \*Water treatment, Water quality, Trends, \*Potable water, Treatment facilities, Costs. \*Waste water treatment,

Because of the small amount of potable water needed when compared with the amount of waste water that must be treated, the term 'water quality' water that must be treated, the term 'water quality' will replace the term 'water pollution control' in the 80's. There will probably be a trend toward the use of dual systems. One would be a small, high quality system, while the second larger system, would provide water of lesser purity for secondary purposes. There will be two separate water distribution systems. The use of water may decline because of higher costs. However, new treatment methods or new energy production systems may make water treatment more economical than expected. There will be a trend away from advanced wastewater treatment facilities because they are wastewater treatment facilities because they are too costly. Secondary plants can remove up to 85% of the pollutants, and special plants for drinking water can remove the last 15%. Economical plant management is the factor which will probably have the greatest influence in this decade. (Small-FRC)
W81-03907

LOW COST SLUDGE DIGESTION,

Severn-Trent Water Authority, Birmingham (England). Directorate of Scientific Services.

G. P. Noone. Water Services, Vol 84, No 1018, p 714, 717, December, 1980. 6 Ref.

Descriptors: \*Anaerobic digestion, Research and development, Waste water treatment, \*Sludge digestion, Pilot plants, Economics, Equipment, \*Sludge treatment, Anaerobic conditions, Mixing,

The Severn Trent Water Authority is working on ways to extend the applicability of anaerobic sludge digestion as a sludge stabilization process. Previous work in this area has shown that anaerobic digestion systems have not operated at their maximum efficiency due to their failure to fully exploit the activities of the microorganisms. The current systems may be uprated by improving the processing inputs of mixing, heating and sludge feeding regimes. These improvements require revised design parameters to service populations of 50,000. The Water Authority has installed a package digestion system servicing about 3000-4000 persons to demonstrate the feasibility of prefabricated systems with regard to volumetric provisions. Standardization of equipment aids in reducing the costs of the digester operations. After 7 months, the performance of the plant has been stable. Other advantages of the system include ease of plant construction and short (only 18, days) of plant construction and short (only 18 days) detention time. (Geiger-FRC) W81-03900

ENERGY CONSERVATION AND SCALE-UP STUDIES FOR A WASTEWATER TREATMENT SYSTEM BASED ON A FIXED-FILM ANAERO-BIC BIOREACTOR,
Oak Ridge National Lab., TN.
R. K. Genung, W. W. Pitt, Jr., G. M. Davis, and J.

H. Koon. Biotechnology and Bioengineering, Vol 22, No 10, (Symposium), p 295-316, 1980. 14 Fig, 5 Tab, 5

Descriptors: \*Waste water treatment, \*Anaerobic conditions, \*Energy conservation, Oak Ridge National Laboratory, Activated sludge, Pilot plants, Biodegradation, Costs, Capital costs, Operating costs, Economics, Engineering.

Oak Ridge National Laboratory has developed a fixed-film anaerobic bioreactor for waste water treatment. It requires considerably less energy to operate than conventional systems and recovers operate than conventional systems and recovers significant quantities of methane produced by anaerobic digestion of carbonaceous wastes. Compared with the activated sludge process, this system uses only 60% of the energy when treating dilute waste waters and 30% of the energy when treating strong waste waters. This system, which meets EPA's standards for secondary treatment, may be scaled up to 1 million gallons per day, sufficient for 86% of publically owned treatment works in the U.S. (Cassar-FRC) W81-03910

MIXING IN LARGE-SCALE MUNICIPAL SOLID WASTE--SEWAGE SLUDGE ANAERO-BIC DIGESTERS,

Municipal Environmental Research Lab., Cincinnati, OH. S. C. James, C. C. Wiles, J. T. Swartzbaugh, and R. B. Smith.

Biotechnology and Bioengineering, Vol 22, No 10, (Symposium), p 259-272, 1980. 5 Fig, 11 Tab, 7 Ref.

Descriptors: \*Anaerobic digestion, \*Sludge digestion, \*Municipal wastes, Sewage sludge, Solid wastes, Mixing. Biodegradation, Digestion, Digestion tanks, \*Waste treatment, Equipment, Wastes,

Mixtures of municipal solid waste and municipal sewage sludge were processed in a 10.7 meter diameter anaerobic digester. Results were not satisfactory because solids coalesced into floating fibrous nets which interfered with mixing and consequently with enzyme and bacterial movement. Gritty cellulosic feedstock also caused excessive wear on pumps. The mechanical satisfary became wear on pumps. Gritty cellulosic feedstock also caused excessive wear on pumps. The mechanical agitator became fouled with rope-like stringers of cellulosic material, causing decreased efficiency and strain on the drive mechanism. Five gas mixing and four mechanical mixing tests were done with varying feed ratios (3:1 or 9:1 solid wastersewage sludge), loading rates (1.25 to 3.125 grams volatile solids per liter per day), and solids in feed (4-10%). For proper mixing, a 50-100 horsepower mechanical mixer would be required at the cost of additional energy requirements. (Cassar-FRC) W81-03911

SEPARATION OF HEAVY METALS FROM AQUEOUS SOLUTIONS USING BIOSOR-BENTS-DEVELOPMENT OF CONTACTING DEVICES FOR URANIUM REMOVAL,

Oak Ridge National Lab., TN.
S. E. Schumate, II, G. W. Strandberg, D. A.
McWhirter, J. R. Parrott, Jr., and G. M. Bogacki.

Biotechnology and Bioengineering, Vol 22, No 10 (Symposium), p 27-34, 1980. 4 Fig, 11 Ref.

Descriptors: \*Nuclear wastes, \*Adsorption, \*Bacteria, Uranium, Heavy metals, \*Waste water treatment, Metals, Separation techniques.

A mixed culture of denitrifying bacteria was tested as a method of removing uranium from waste waters. In a batch contacting device, the bacteria reduced the uranium concentration from 100 g per cultural to about 3 g per culture within 15 reduced the uranium concentration from 100 g per cu meter to about 3 g per cu meter within 15 minutes. Temperature in the range of 25-50C had no effect on the process. In a test with a continuous countercurrent contacting device, initial uranium concentration was reduced from 25 g per cu meter 10 0.5 g per cu meter in 8 minutes. Mass transfer rates were impossible to obtain because analytical techniques were too slow to obtain values during the initial stages. (Cassar-FRC) W81-03912

CARBON REMOVAL AND NITRIFICATION IN A ROTATING BIOLOGICAL CONTACTOR UNDER DIFFERENT STEADY-STATE CONDI-

Ben Cor Construction Co., Chattanooga, TN. R. W. Lowhorn, R. B. Bustamante, and W. P.

Biotechnology and Bioengineering, Vol 22, No 10, (Symposium), p 273-293, 1980. 16 Fig, 1 Tab, 27 Ref.

Descriptors: \*Nitrification, \*Waste water treat-ment, \*Rotating biological contactors, Chemical oxygen demand, Dissolved oxygen, Temperature, Organic compounds, Nitrogen compounds, Sodium bicarbonate, Buffers, Pilot plants, Hydrogen ion concentration, \*Carbon removal.

A pilot plant study of a rotating biological contactor monitored the degradation of soluble organics and measured the effect of process parameters during the treatment of a synthetic waste water. Temperatures between 13.0 and 22.0C had no effect on the process. Chemical oxygen demand removal was adversely affected by inadequate buffering, too-low rotational speed, and insufficient time for biomass development. Good nitrification required sodium bicarbonate addition to provide a source of inorganic carbon. A too-high rotational time for biomass development. Good nitrification required sodium bicarbonate addition to provide a source of inorganic carbon. A too-high rotational speed tended to strip CO2 from the solution and inhibit nitrification. A description of the five steady state experiments follows: (1) pH dropped from 7 to 5.8. Dissolved oxygen increased from 1.4 mg per liter to 7.05 mg per liter. COD removal was 81% in the steady state, but changed from 54.5 to 88.7 mg per liter in the effluent, producing an odorous, yellow liquid. Ammonia-N decreased by 33.1 mg per liter, and nitrate-N increased by 33.6 mg per liter. (2) The feed solution was highly buffered with mono- and di-basic potassium phosphates and the rotational speed increased; pH was held at 7.1. COD removal was 94%. Although ammonia-N levels decreased by 15 mg per liter, explittle nitrate or nitrite-N were formed. After addition of NaHCO3 as an inorganic C source, nitrate-N reached a level of 3.6 mg per liter. (3) This run began with added NaHCO3. The pH varied little from 7.3; dissolved oxygen was 6.4 mg per liter, minimum. COD was similar to 2, and the degree of nitrification was slightly greater. (4) A reduced rotational speed improved nitrification (5.2 to 44 mg per liter). (5) Conditions were similar to those in 1, with similar results. However, more COD removal, 93.5%, and greater nitrification took place. (Cassar-FRC) w81-03914

ALGAL CONCENTRATION AND SPECIES COMPOSITION IN EXPERIMENTAL MATURATION PONDS WITH EFFECTS OF AERATION AND RECIRCULATION, Orange Free State Univ., Bloemfontein (South Africa). Inst. for Environmental Sciences. S. N. Shillinglaw, and A. J. H. Pieterse. Water SA, Vol 6, No 4, p 186-195, October, 1980. 3 Fig. 3 Tab, 16 Ref.

Descriptors: \*Eutrophication, \*Aeration, \*Mixing, Water pollution effects, Ponds, Algae, Cyano-

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

# Waste Treatment Processes—Group 5D

phyta, Chlorophyta, \*Nutrient removal, Eugleno-phyta, Africa, Daspoort sewage works, Pretoria.

The effects of aeration and agitation on algal levels The effects of aeration and agitation on algal levels in maturation pond systems receiving humus tank effluents from the Daspoort, Pretoria sewage treatment works were studied over a 12 month period. The three pond systems studied exhibited wax and wane patterns of algal growth according to an algal concentration index which was developed to compare phytoplankton growth patterns of the three systems. High algal concentrations were maintained in the aerated pond, while decreases in algal levels were found during summer and winter in the non-agitated and recirculated systems. Dealgal levels were found during summer and winter in the non-agitated and recirculated systems. De-clines in algal levels occurred only during the summer in the aerated ponds. The overall domi-nant algae were members of the chlorophyceae, while these species plus Euglenophyceae, Crypto-phyceae and Cyanophyceae dominated during dif-ferent algal pulse periods. In the nonagitated sys-tems, a seasonal algal succession was observed. (Geiger-FRC) W81-03925

# UNDERSTAND WASTEWATER TREATMENT CHEMICAL PROCESSES,

M. A. Vivona Water and Wastes Engineering, Vol 17, No 8, p 20-23, 36, August, 1980. 2 Fig, 8 Tab.

Descriptors: \*Chemical reactions, \*Biological oxygen demand, \*Disinfectants, Anaerobic digestion, Wastewater treatment, Aeration, Chemical precipitation, Adsorption, Chlorination, Sludge di-

gestion, Ozone

Efficiency of waste water treatment may be improved by understanding the individual chemical processes and their transfer and/or reaction rates. Examples of these processes are aeration, precipitation, adsorption, aerobic and anaerobic digestion, biochemical and chemical oxidation, fermentation, wet and dry incineration, and disinfection. Reac-tion rates depend on several factors, including conuon rates depend on several factors, including con-centration, pressure, pH, temperature, and contact probability. Several types of interactions are possi-ble, gas-liquid transfer being the most important. Details are given for the BOD process, chlorine and ozone disinfection, anaerobic digestion, and aerobic digestion. (Cassar-FRC) W81-03929

# WASTEWATER REUSE IN SAUDI ARABIA:

WASTEWATER REUSE IN SACREMENT AND ASSESSED AND ASSESSED ASSESSEDAD ASSESSED ASSESSED ASSESSED ASSESSED ASSESSED ASSESSED ASSESSED

Descriptors: \*Wastewater renovation, \*Water reuse, \*Municipal wastewater, Demineralization, Desaination, Pretreatment of water, Oil refineries, Industrial plants, \*Oil industry, Lime, Chemical recovery, Wastewater facilities, \*Saudi Arabia.

The shortage of water in the area made process water a major concern when the General Petroleum and Minerals Organization of Saudi Arabia (Petromin) decided to double the capacity of an oil refinery near the city of Riyadh. As a result, Petromin agreed to reclaim the effluent from the Riyadh min agreed to reclaim the effluent from the Riyadh wastewater treatment plant for use in the refining process. The wastewater reclamation facility is being designed to process an effluent flow of 5.3 million gallons per day (MGD) to achieve the three quality levels of water needed in the refining process. The effluent is first pumped into surge ponds, chlorine is added, and the wastewater is aerated. The wastewater then begins the pretreatment process, which includes treatment in a two-compartment rapid-mix basin in which lime is compartment rapid-mix basin in which lime is blended with the effluent, followed by cooling, gravity filtration, and carbon adsorption processes. The effluent from this pretreatment process then advances to the demineralization system. Reverse advances to the demineralization system. Reverse osmosis followed by a second reverse osmosis system and ion exchange to polish the effluent was selected for desalinization and demineralization of the pretreated wastewater. The system produces low-grade water for general utility water and for

fire protection following the second stage lime hre protection following the second stage lime pretreatment, a better quality water with reduced dissolved solids for use in desalting crude oil and to replace water losses in the refinery's cooling towers following the first reverse osmosis stage, and a high quality water for use in the high-pressure boiler system following the ion exchange process. Processes which recover and recycle chemicals are being incorporated throughout the facility. It is anticipated that 70 to 80% of the lime shudes will be recovered and resured. Sent carbon facility. It is anticipated that 70 to 80% of the lime studge will be recovered and reused. Spent carbon from the carbon adsorption columns will be recovered by thermal regeneration in a fluid-bed reactor. The facility design also allows for the ion exchange system to be bypassed when possible. (Carroll-FRC) W81-03930

REDUCE LAGOON ALGAE PROBLEMS WITH COAGULANTS, Army Engineer Waterways Experiment Station, Vicksburg, MS. M. J. Cullinane, Jr., and R. A. Shafer. Water and Wastes Engineering, Vol 17, No 6, p 19-21, June, 1980. 3 Fig, 1 Tab.

Descriptors: \*Wastewater lagoons, \*Algal control,

\*Alum, Wastewater treatment, Lagoons, Coagula-tion, Chemical coagulation, Algae, Effluents, Sus-pended solids, Chemical oxygen demand, Biologi-cal oxygen demend, Phosphates.

The need to provide economical wastewater treatment at facilities having extremely small continuously, seasonally, or intermittently discharging lagoons has led the U.S. Army Corps of Engineers to investigate in-pond or in-situ techniques for removing algae solids and improving lagoon effluent quality. A study was devised on the technical feasibility of using the addition of alum to small lagoons for these purposes. Two similar lagoons receiving wastes from identical washroom facilities in similar camping areas at a recreational facility were used for the study. Liquid alum was added to the test lagoon from a container on a motorized boat, which was then driven in figure-eights at different speeds to provide rapid mixing followed by slow mixing. The addition of the alum resulted in removal of 99% of the total phosphates and orthophosphates, a 50% reduction in chemical oxygen demand, a 75% reduction in the unfiltered biological oxygen demand (BOD5), a 99% reduc-The need to provide economical wastewater treatgical oxygen demand (BOD5), a 99% reduc tion in algae counts, and a reduction of suspended solids concentrations to 10 milligrams per liter.
Cost analysis indicated that if the top four feet of Cost analysis indicated that if the top four feet of the treated lagoon had been discharged, the cost incurred for labor, alum, and freight expense would have been about \$0.35 per 1,000 gallons discharged. The in-pond addition of alum has direct application to small-scale treatment systems with intermittent or seasonal wastewater discharges. (Carroll-FRC) W81-03931

#### COORDINATE PLANT START-UPS EARLY, Washington Suburban Sanitary Commission, Hyattsville MD.

Water and Wastes Engineering, Vol 17, No 6, p 42-43, 47, 48, June, 1980. 3 Fig.

Descriptors: \*Wastewater treatment, \*Training, \*Personnel, Wastewater facilities, Handbooks, Publications, Maintenance, District of Columbia area, Maryland, Accokeek, Upper Marlboro.

The experiences of the Washington Suburban Sanitary Commission (WSSC) which serves two Maryland counties just outside Washington, District of Columbia, in starting up two new facilities may provide some guidelines for future plant start-ups for sanitary agencies. The two WSSC plants discussed are the Piscataway model 5 MGD advanced wastewater treatment plant in Accokeek, Maryland, and the Western Branch 30 MGD advanced wastewater treatment plant in Upper Mariand MGD advanced wastewater treatment plant in Upper MGD a Maryland, and the Western Branch 30 MGD advanced wastewater treatment plant in Upper Mariboro, Maryland. When the Piscataway model plant was constructed, a staff of new operators was hired, complemented by three experienced secondary plant operators. Training consisted of classroom instruction and hands-on training at the un-

finished facility. The West Branch plant employed a four-step planning approach to the start-up, which included: (1) 9 months of pre-start-up reparatory work including plant inspections and modifications, development of preventive maintenance schedules, writing of operating procedures, training operators, and establishing an intial equipment check-out; (2) gradual introduction of raw wastewater to the new plant; (3) concurrent operation of the old plant during the flow diverting process; and (4) start-up of the new solids handling building. Construction specifications should include initial equipment start-up and training of the plant staff in operations and maintenance by certified manufacturer representatives. The interrelationships between equipment and adjacent processes should be explained. Literature distributed to staff should include equipment diagrams, operating procedures, maintenance schedules, lubrication schedules, and safety procedures, Manufacturer's operations and maintenance manuals should provide information germane to the plant operations, including specific repair procedures, emergency finished facility. The West Branch plant employed vide information germane to the plant operations, including specific repair procedures, emergency start-up and shut-down procedures, parts inventories, and the particular application at the treatment facility. The designer's operations and maintenance manuals should be geared to the level of understanding of the actual operating and maintenance personnel. An extended start-up services contract should be obtained with an appropriate manufacturer or consultant. (Carroll-FRC) W81-03934

# FLUIDIZED BEDS IMPROVE TREATMENT.

CUT COSTS, Lockwood, Kessler and Bartlett, Inc., Great Neck,

M. Barbara, F. Flood, and J. Jeris. Water and Wastes Engineering, Vol 17, No 6, p 35-37, June, 1980. 2 Fig. 2 Tab.

Descriptors: \*Wastewater treatment, \*Fluidized bed process, Economic aspects, Capital costs, Maintenance costs, Operating costs, Biological wastewater treatment, Sludge thickening.

Fluidized bed technology combines fixed biological film attachment and high biomass concentrations, maximizing biological waste treatment efficiency while reducing sludge handling and chemical costs. The Hy-Flo fluidized bed system, a parented process, consists of a bioreactor partially filled with a fine-grained medium, such as sand, which is fluidized as wastewater is passed upward through the bottom of the reactor. The surface of the sand becomes covered with a firmly attached, active biomass which consumes the contaminants active biomass which consumes the contaminants in the wastewater. The biomass concentrations in this system are higher than those in conventional activated sludge systems. The fluidized bed system uses a positive solids removal mechanism which includes particle size control and eliminates the need for secondary clarification following the bior-eactor. A very high concentration of microorganeactor. A very high concentration of microorganisms, which can be any of the facultative, aerobic, or anaerobic bacteria normally used in treatment systems, is maintained within the reactor. Prefabricated modules which require only piping and electrical connections to be made fully operational can enable existing treatment plants to expand rapidly and economically. The modules can generally interface effectively with existing equipment without a considerable increase in area requirements. Steel or concrete in-ground tanks in large installations make the fluidized bed system an attractive alternative to activated sludge or rotative. attractive alternative to activated sludge or rotating biological contactors. These tanks eliminate the need for influent pumping and minimize excavation and concrete form work, significantly reducing system down-time and capital cost expenditures. (Carroll-FRC) W81-03935

# COOPERATION FORMS FOUNDATION FOR WWTP GROWTH,

Killam (Elson T.) Associates, Inc., Millburn, NJ.

R. C. Moore. Water and Wastes Engineering, Vol 17, No 6, p 44-47, June, 1980. 1 Fig. 1 Tab.

# Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

# **Group 5D—Waste Treatment Processes**

Descriptors: \*Wastewater facilities, \*Regional planning, \*Interagency cooperation, Wastewater treatment, Planning, Construction, Flood control, Municipal wastewater, Industrial wastewater, Secondary wastewater treatment.

In the early 1960's, the Joint Meeting wastewater treatment plant in New Jersey was ordered to plan to provide secondary treatment at its then 30-year-old primary treatment plant. The new facilities had to be tailored to make maximum use of the existing facilities and had to fit on a limited site with poor foundation conditions. Discussions with the U.S. Army Corps of Engineers over a period of years resulted in combining the construction of a portion of planned flood control levees with the treatment of planted mode control revess with the realment plant construction, eliminating the planned encroachment of the proposed levees on the plant site and allowing Joint Meeting to take advantage of the river relocation and straightening included in the flood control scheme. The foundation was prepared by excavating more than 450,000 cubic prepared by excavating more than 450,000 cubic yards of swamp peat and replacing it with about 600,000 cubic yards of sand, which was compacted to provide a foundation for the facilities and road-ways. The existing primary facilities were upgraded alkaline, and pilot studies were initiated to determine the treatability of the highly industrial wastes. An activated sludge process was adopted using conventional design parameters, and the new secondary treatment plant was integrated with the existing primary treatment plant. (Carroll-FRC) W81-03936

HOW SAFE ARE YOUR SEWAGE WET WELLS,

For primary bibliographic entry see Field 8C. W81-03937

NASSAU COUNTY REMOVES TARGET METALS FROM WASTEWATER. Lockwood, Kessler and Bartlett, Inc., Syosset,

D. Giller Water and Wastes Engineering, Vol 17, No 5, p 38, 39, 42, 46, 51, 52, May, 1980. 7 Fig, 3 Tab, 15 Ref.

Descriptors: \*Water pollution control, \*Heavy metals, \*Incineration, Metals, Lime, Polymers, Wastewater treatment, Cadmium, Zinc, Lead, Manganese, Chemical precipitation.

After characterization of waste water from two municipal refuse incinerators in Oyster Bay, New York, a treatment process was designed to remove heavy metals. Raw effluent, composed of 80% scrubber water and 20% quench water, contained high levels of heavy metals. Lime and polymer addition removed 90-97% of the target metals (Cd, Zn, Mn, and Pb). Pb. could not be reduced below the required limit of 0.10 mg per liter. Primary coagulants, alum, ferric chloride, and sodium carbonate, did not significantly improve metal remov-al with the exception of Cd. (Cassar-FRC) W81-03938

INDIRECT WATER REUSE PROBLEMS CAN BE SOLVED AT REASONABLE COSTS R. L. Culp.

Water and Wastes Engineering, Vol 17, No 5, p 20, 23-26, May, 1980. 1 Fig, 1 Tab.

\*Water reuse, Descriptors: \*Self-purification, Descriptors: "water reuse, "Sell-purincation, "Water quality, Optimization, Water treatment, Waste water treatment, Effluents, Water pollution, Aesthetics, Water purification, Streams, Sites, Costs, "Water treatment facilities, Planning.

Optimum conditions for location of waste water reatment plants upstream from water treatment plants are evaluated. Three primary factors determine the quality of potable water in this situation: waste water treatment plant size and effluent qual-ity, stream self-purification, and water treatment plant size and processes. Each of these three fac-tors includes a wide range of purification capability, and each may be optimized to provide good quality drinking water for the lowest cost. The minimal allowable stream distance between the two plants is important, and each case must be considered individually. Sewer effluent outfalls considered individually. Sewer enhanced outsians should not be located too close to water treatment plant intakes. Many engineers suggest 24 hours travel-storage time a minimum. Other considerations in determining distance between plants are pollution from nonpoint sources and surface runoff, aesthetics, and organic chemicals. Nine alternative combinations are compared in a table. (Cassar-FRC) W81-03940

USE RENEWABLE ENERGY

WASTEWATER TREATMENT,
Metropolitan Denver Sewage Disposal District
No. 1, CO. D. Wann.

Water and Wastes Engineering, Vol 17, No 4, p 36-37, 39, April, 1980. 2 Tab, 5 Ref.

Descriptors: \*Energy conservation, \*Solar energy, \*Fuel cells, Efficiencies, Wastewater treatment, Electric motors, Electric power generation, \*Wastewater facilities.

Renewable energy sources such as bio-gas, wind, fuel cells, solar cells, and hydroelectric power are fuel cells, solar cells, and hydroelectric power are possible substitutes for petroleum-generated energy in waste water treatment plants. Improved motor efficiency, heat jackets, and energy wheels can add to energy savings. Several experimental systems are in operation. BioGas of Colorado has installed a system on a 50,000 cu ft digester which uses a 600 sq ft collector to provide 70% of the digester's annual heat requirements. The Wilton, Maine, waste water plant, constructed with federal assistance, uses solar energy and bio-gas. (Cassar-FRC) W81.03948. W81-03943

DETERMINE SLUDGE AGE WITH CLARI-

Atlanta City Research and Development, GA. P. R. Karr, R. B. Smith, and M. Masingale. Water and Wastes Engineering, Vol 17, No 4, p 30, 35, 47, April, 1980. 1 Fig. 2 Tab, 7 Ref.

Descriptors: \*Sludge digestion, \*Activated sludge, \*Clarifiers, Wastewater treatment, Digestion, Suspended solids, Aeration, Aging.

This study supports the inclusion of clarifier solids in the calculation of sludge age. This is necessary when the solids enter at a rate greater than they are removed, causing an accumulation of solids in are removed, causing an accumulation of soiles in the clarifier, a decrease in solids in the aeration tank, and variability in sludge age values through-out the day. Comparison of three methods of de-termining solids in the clarifier showed that the sludge judge (a vertical core sampler) provided a direct measure, while the mixed liquor suspended direct measure, while the mixed liquor suspended solids method gave high results and the blanket volume method, low results, for a 1 ft thick sludge blanket. For an 8.5 ft sludge blanket depth, the mixed liquor suspended solids method gave low results, and the blanket volume method, high results. Best results were obtained when the activated sludge solids in the total system were considered (Genez ERC). ered. (Cassar-FRC) W81-03944

COMPUTERIZING BREAKDOWNS MAY IMPROVE WASTEWATER TREATMENT EQUIP-

Weston Designers-Consultants, West Chester, PA. For primary bibliographic entry see Field 7C. W81-03946

ECONOMICALLY REMOVE TOXICS, Houston Research, Inc., TX.
For primary bibliographic entry see Field 5F.

W81-03948

FEDERAL INDUSTRIAL PRETREATMENT PROGRAM: WONDERLAND REVISITED, Black and Veatch, Kansas City, MO. G. R. Miller, P. E. Schafer, and R. E. Vansant.

Water and Wastes Engineering, Vol 17, No 2, p 16-19, February, 1980.

Descriptors: \*Industrial wastes, \*Chemical wastes, Pretreatment program, Federal Wastes, \*Chemical Wastes, \*Pretreatment program, Federal Water Pollution Control Act, Legislation, Water pollution control, Governments, \*Wastewater treatment, Legal as-pects, Management, Pretreatment of water.

The federal municipal pretreatment program originated in the 1972 Water Pollution Control Act and has been shaped by the courts. Although the local governments which operate the sewerage facilities have the burden of enforcing pretreatment programs, they have little input into settlement agreements resolving lawsuits. Waste water utility managers have enthusiasm for the goals of the program and doubts about the costs and degree of freedom in implementation. A problem solving approach to controlling toxic materials in influents is presented and contrasted with the way the regulations are and contrasted with the way the regulation being interpreted in the courts. (Cassar-FRC) W81-03950

# 5E. Ultimate Disposal Of Wastes

A TECHNIQUE FOR EVALUATING THE HY-DRAULIC CONDUCTIVITY OF SAPROLITE, North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences. C. W. Welby.

C. W. Welby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215634, Price codes: A03 in paper copy, A01 in microfiche.
North Carolina Water Resources Research Institute, University of North Carolina, Report No 164, April, 1981. 38 p, 8 Fig. 7 Tab, 3 Ref. OWRT-A-115-NC(1), 14-34-0001-1135.

Descriptors: Permeability coefficient, \*Rock properties, Permeameters, Measuring instruments, \*Waste dumps, \*North Carolina, Technology, Hydraulic structures, Hydraulic permeability, Permeability, Transmission constant, Cores, Sampling, Standards, Waste disposal, Water pollution, Landfills, Field tests, On-site tests, Porous media, \*Saprolite, \*Hydraulic conductivity.

Increased emphasis on stringent controls of solid/ hazardous wastes burial sites and the need in North nazardous wastes ourial sites and the need in Norm Carolina for a rapid cost-effective evaluation of potential sites for such purpose required a quick, reasonably accurate method for determining hy-draulic conductivity (HC) of saprolite developed on the crystalline rocks of the Piedmont Province. Development of such a method is reported using an adapted commercially-available flow meter as a field instrument, tested with artificial standards composed of Portland cement and sand mixtures in various ratios. The standards related instrumentvarious ratios. The standards related instrument-measured air permeability to HC of standard/field samples encased in heat-shrinkable plastic. Sapro-lites were studied (250 cores) from various rock types. Average HCs from air permeameter values on dry samples were in the 0.001 cm/sec range; sandy saprolite HCs, in the 0.01 cm/sec range; HCs of some relatively pure clays were 0.0001, 0.0001 meter/sec. It was concluded that the air permeameter can be a useful, cost-effective instru-ment for systematic ranif study of sarrolite HC. as ment for systematic rapid study of saprolite HC, as well as an effective tool for reconnaissance HC determinations at proposed waste disposal sites. (Zielinski-IPA) W81-03605

AUTOMATED CONTRITREATMENT SYSTEMS, CONTROL OF SLUDGE

Japan Sewage Works Agency, Tokyo. Research and Technology Development Div. M. Kashiwaya, K. Azuma, and A. Kuwayama. In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 89-119. 6 Fig.

Descriptors: \*Wastewater treatment, \*Wastewater facilities, \*Sludge disposal, \*Automation, \*Process control, Effluents, Influents, Sludge thickening, Sludge digestion, Incineration, Monitoring, Computers, Data acquisition, Control systems, Sludge drying, Sludge treatment, \*Japan.

#### WATER QUALITY MANAGEMENT AND PROTECTION-

# Ultimate Disposal Of Wastes-Group 5E

In sludge treatment systems increasing numbers of In sludge treatment systems increasing numbers of measuring instruments and control equipment are being applied to ensure stable operation of each system and to ensure high quality effluent in spite of qualitative and quantitative fluctuations of sewage inflow. Process operation and control techniques are available for sludge gravity thickening, sludge digestion, digested sludge clutriation, chemical conditioning, sludge devatering, sludge incineration, and heat treatment. Monitoring and control systems are becoming more complex, with control systems are becoming more complex, with control systems are becoming more complex, with increasing reliance on computer control. Operation and control methods, now in the projected or experimental stages rely on computer, feedback and feed-forward controls. Their full development and reed-torward controls. Their full development will make it possible to computerize the automatic control of sludge treatment systems. Provision must be made for auxiliary treatment if the main process becomes faulty, and for automated or operator-managed data collection. (Brambley-SRC) W81-03613

ENGINEERING EVALUATION OF MUNICIPAL SLUDGE INCINERATORS,
Japan Sewage Works Agency, Tokyo. Research and Technology Development Div.
K. Ohmiya, and S. Takahashi.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology,
May 19-21, 1980, Tokyo, Japan. Environmental
Protection Agency Report EPA-600/9-80-047, December, 1980, p 121-166. 11 Fig, 12 Tab, 2
Append.

Descriptors: \*Incinerators, \*Municipal wastes, \*Sludge disposal, \*Economic aspects, \*Evaluation, Air pollution, Dewatering, Fluidized beds, Cen-trifugation, Sludge drying.

In spite of the energy requirements and environ-mental costs, incineration of sewage sludge has become unavoidable for some municipalities in Japan. Based on data from three multi-hearth, two fluidized bed and two rotary kiln incinerators, en-gineering and economic evaluations are made on gineering and economic evaluations are made on the different incinerators. Only the multi-hearth furnace can cope with more than 100 tons wet base/day per unit. The fluidized bed furnace re-quires skilled operators during use, but can be used case/any per unit. The fluidized bed furnace requires skilled operators during use, but can be used intermittently, produces less odor, works at lower operating air supply rates, and needs dust collectors to keep ash out of the exhaust gases. All three incinerators emit approximately the same amounts of nitrogen oxides and sulfur oxides. The cheapest dewatering system was the centifuge, when compared with vacuum filtration and filter pressing, but when combined with incineration, the cheapest combination was the filter press and multi-hearth furnace. The fluidized bed was the most expensive, because of high fuel costs, unless after-burning of the exhaust gas is undertaken. The installation cost of combined systems is highest when the filter press is used, and the space used is smallest when the fluidized bed is used, regardless of the other components. (Brambley-SRC)

INSTRUMENTATION AND AUTOMATION CONTROL OF MUNICIPAL SLUDGE TREATMENT FACILITIES,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
I. J. Kugelman, R. C. Polta, D. Stulc, and G. A.

Mannes.
In: Proceedings; Seventh United States/Japan
Conference on Sewage Treatment Technology,
May 19-21, 1980, Tokyo, Japan. Environmental
Protection Agency Report EPA-600/9-80-047, December, 1980, p 453-514. 23 Fig, 4 Tab, 11 Ref, 2
Append

Descriptors: \*Sludge conditioning, \*Sludge drying, \*Sludge disposal, \*Automation, Wastewater treatment, Computers, Municipal Dewatering, Cost analysis, Control

Costs for dewatering and ultimate disposal of sludge from primary and secondary wastewater treatment range from 30% to 50% of the total treatment expense. One potential method of reduc-

ing costs in this area is the application of instru-mentation and automation to process control of dewatering and ultimate disposal. To date control strategies, and instrumentation packages to auto-mate operation based on these control strategies, have been developed for the three individual unit operations of cher operations of chemical conditioning, vacuum filtra-tion and multiple hearth incineration. The strategy from an infinite nearth incirculation. In estrategy for chemical conditioning provides for predictive control of the sludge dewaterability by manipulating the chemical dose. The strategy for vacuum filtration provides for feed forward control of filter yield or moisture content of the filtered sludge. For the incinerator, control of the furnace temperature profile will be accomplished by manipulation of fuel feed to the various hearths and control of the flow of air into the furnace. The control strategies which have been developed and which will be implemented at this site can be used to optimize the performance of each unit operation. (Moore-SRC) W81-03620

PARALLEL EVALUATION OF BELT FILTER PRESSES AND LOW SPEED SCROLL CENTRI-

Los Angeles County Sanitation Districts, Whittier,

CA.
W. E. Garrison, and R. W. Horvath.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 579-606. 10 Fig. 1 Tab, 2 Ref.

Descriptors: \*Sludge drying, \*Centrifugation, \*Fil-tration, \*Wastewater treatment, Activated sludge, Sludge disposal, Digested sludge, Primary sludge, \*Carson, California.

The Joint Water Pollution Control Plant in Carson, California serves as a central solids processing facility for the Los Angeles County Sanitation Districts. In the 1970's, both Federal and California discharge standards were enacted which California discharge standards were enacted which required an increased level of treatment at the plant, including a ban against the discharge of sludge into the Pacific Ocean. Dewatering studies were conducted to select equipment needed to treat the large amount of waste activated sludge which will be produced when secondary treatment commences, and digested primary sludge production exceeds the capacity of existing equipment. Full scale, long term tests were conducted using two belt filter presses and two low speed scroll centrifuges. The belt filter press and a low speed scroll centrifuge with automatically controlled backdrive can achieve equivalent performance on digested primary sludge, and blended sludge containing as much as 50% by weight of digested waste activated sludge. Both the belt filter press and the low speed scroll centrifuge can achieve a wide variety of results on any given sludge, depending on the selection of feed rate and polymer dosage, and the adjustments of various mechanical features. Both types of device were relatively easy to start up and operate. (Moore-SRC) required an increased level of treatment at the

THERMAL CONVERSION OF SLUDGE IN A MULTIPLE HEARTH FURNACE, USING A SUB-STIOCHIOMETRIC SUPPLY OF

OXYGEN, Municipal Environmental Research Lab., Cincinniti, OH. Wastewater Research Div. I B Farrell

J. B. Farrell.

In: Proceedings; Seventh United States/Japan
Conference on Sewage Treatment Technology,
May 19-21, 1980, Tokyo, Japan. Environmental
Protection Agency Report EPA-60/9-80-047, December, 1980, p 607-631. 8 Fig, 3 Tab, 9 Ref.

Descriptors: \*Sludge disposal, \*Incineration, \*Fuel, \*Waste disposal, Recycling, Wastewater treatment, Waste recovery, Adsorbents, Heavy metals, Pollutants.

Thermal conversion with sub-stoichiometric oxygen supply (TC-SSOS) is a method being considered for municipal sludge disposal. By controlling the air supply, a multiple hearth furnace can

be operated to discharge a combustible gas at the top hearth and an inert residue from the bottom hearth. The combustible gas should have sufficient heat of combustion to burn completely in an afterburner, reducing unburned hydrocarbon to acceptable levels. Four thermal conversion modes were able levels. Four thermal conversion modes were used during these investigations: incineration (with greater than stoichiometric oxygen supply), low temperature char (LTC), high temperature char (HTC), and carbon burned ash (CBA). Experiments with actual sludge samples demonstrate the feasibility of operating a multiple hearth furnace in the CBA, LTC, and HTC modes, to produce a burnable gas. Heat recovery is feasible and no additional fuel is needed for afterburning. HTC and LTC char have interesting potential as adsorbents for wastewater treatment. LTC char has a heat of combustion equivalent to some low quality coals and could serve as a fuel. The LTC char neat or comoustion equivalent to some low quality coals and could serve as a fuel. The LTC char should also contain most of the heavy metals which conceivably could be removed or recovered from it. (Moore-SRC) W81-03624

CURRENT DESIGN AND OPERATING EXPERIENCE WITH ANAEROBIC SLUDGE DIGES-

Los Angeles County Sanitation Districts, Whittier,

Los Angeles County Sanitation Districts, Whitner, CA.
W. E. Garrison, C. A. Nagel, and R. S. Easley.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-60/9-80-047, December, 1980, p 825-862. 18 Fig, 2 Tab, 5 Ref.

Descriptors: \*Sludge disposal, \*Anaerobic digestion, \*Wastewater treatment, \*Energy sources, \*Sludge digestion, Fuel, Biological treatment, Activated sludge, Waste recovery, Odor control, Public health, Methane, \*Los Angeles County,

The Sanitation Districts of Los Angeles County, California, are currently constructing 8.8 cu m/s of high purity oxygen activated sludge treatment facilities. A sludge processing scheme that includes anaerobic sludge digestion was chosen to treat the waste activated sludge from the oxygen activated sludge units. The basic advantages of anaerobic sludge digestion to the Districts include: energy recovery; sludge storage and equalization; reduced odor potential; and reduced health risk. The effiodor potential; and reduced health risk. The efficient and complete utilization of digester gas will provide almost 80% of the energy requirements for the entire plant. Dependable operation and maximum methane gas production have been achieved by providing complete mixing, uniform mesophilic temperatures, and uniform sludge feeding. The design and construction of anaerobic digesters which can be operated at high organic loading at constant supply of digester gas to be produced for energy recovery. The circular digestion system has proven to be an economical design based on construction cost, land utilization, operating costs, and operational flexibility. (Moore-SRC)

SLUDGE COMPOSTING: PROCESSES AND

SLUDGE COMPOSTING: PROCESSES AND FUTURE DIRECTIONS,
Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
A. E. Eralp, and J. B. Farrell.
In: Proceedings; Seventh United States/Japan Conference on Sewage Treatment Technology, May 19-21, 1980, Tokyo, Japan. Environmental Protection Agency Report EPA-600/9-80-047, December, 1980, p 863-882. 7 Fig. 2 Tab, 10 Ref.

Descriptors: \*Composting, \*Sludge disposal, \*Wastewater treatment, \*Biodegradation, Pathogens, Temperature control, Public health, Economies of scale, Cost analysis, Odor control.

Composting primarily directed at converting sewage sludge into useful or easily disposed product was unknown in the United States about 15 years ago. Since then, development of sludge composting has been rapid with several full-scale operations underway and more in the design stage.

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

# **Group 5E—Ultimate Disposal Of Wastes**

Presently the most successful sewage sludge composting operations are both simple and flexible in design and operation, and are based on the staticaerated pile and window techniques. For pathogen control it is recommended that the temperature of the composting sludge be at 55 degrees C or above for a minimum of two days. Composting by either of these two methods takes a minimum of 21 days. Within-vessel composting may be better able to control important parameters, so that the time period can be reduced to one week or even shorter. Additionally, effective odor control, minimum labor, and low maintenance are among the advantages claimed for within-vessel composting. Review of European within-vessel systems indicate that these processes work, but they all apnear to be aerated pile and window techniques. For pathogen that these processes work, but they all appear to be expensive. The processes show little economy of scale, so costs per ton do not decrease much as plant scales increases. Nevertheless, it is evident that within-vessel processes for sludge composting are successful and worthy of consideration by municipalities. (Moore-SRC) W81-03628

CURRENT RESEARCH ON LAND DISPOSAL OF MUNICIPAL SOLID WASTES, Environmental Protection Agency, Cincinnati,

N. B. Schomaker, J. V. Klingshirn, and M. A.

Available from the National Technical Information Available from the National I echnical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: A12 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Pro-ceedings of the Seventh Annual Research Sympo-sium, March 16-18, 1981, Philadelphia, Pennsylva-nia. Shultz, D. W., Ed., Environmental Protection Agency Report EPA-600/9-81-002a, March, 1981, p vii-xii.

Descriptors: "Municipal wastes, "Land disposal, "Leachates, "Landfills, "Pollutants, Waste disposal, Remedies, Decomposition, Cost analysis, Water pollution control, Water pollution prevention, Liners, Industrial wastes, Wastewater disposal, Geomedium resultivities." Groundwater pollution.

The current EPA municipal solid waste disposal research program has been divided into three gen-eral areas: pollutant predictions for current landfill techniques; alternatives to current landfill disposal techniques; and remedial action for minimizing pollutants from unacceptable sites. The research activities in these three general areas are classified into five categories: leachate forecasting, controlled decomposition, co-disposal, manuals of practice, and economic assessment. Leachate fore-casting includes studies to predict volume and composition of leachates, gas production, and their migration and management. Controlled decomposition is intended to control the quality and volume of leachate production by altering the decomposi-tion processes, controlling waste leachability, and use of liners/membranes/admixtures. Studies are being conducted on co-disposal of municipal wastes with industrial and sewage sludges, with wastes with industrial and sewage studges, with leachate quality control or recirculation. Manuals of practice are being developed concerning the environmental impacts of special types of landfills, sampling and preservation of groundwater, and the sampling and preservation of groundwater, and the use of gas barriers and growth of trees on closed landfills. An effort is being made to evaluate the relative importance of the various factors affecting the costs of sanitary landfills, in order to identify the least costly disposal alternative under local conditions. (Brambley-SRC) W81-03630

LEACHATE PRODUCTION AND MANAGE-MENT FROM MUNICIPAL LANDFILLS: SUM-MARY AND ASSESSMENT,

Calscience Research, Inc., Huntington Beach, CA For primary bibliographic entry see Field 5B. W81-03631

LEACHATE PRODUCTION BY LANDFILLED PROCESSED MUNICIPAL WASTES, Systems Technology Corp., Xenia, OH For primary bibliographic entry see Field 5B. W81-03632

RECOVERY OF FECAL-INDICATOR AND PATHOGENIC MICROBES FROM LANDFILL LEACHATE, Cincinnati Univ., OH.

For primary bibliographic entry see Field 5B. W81-03633

WASTEWATER TREATMENT PLANT RESID-UAL LANDFILLING: A CRITICAL REVIEW, Calscience Research, Inc., Huntington Beach, CA. R. J. Stearns, J. C. S. Lu, and R. D. Morrison. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Page 14 Control of the Page 14 Control of the Control of the Page 14 Control of

Service, Springiteid, VA 22101 as PBs-1788/4, Price codes: Al2 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, Pennsylvania. Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 55-66. 5 Fig. 4 Tab, 26

Descriptors: \*Landfills, \*Leachates, \*Wastewater facilities, \*Literature review, \*Waste disposal, Public health, Environmental effects, Municipal wastes, Pollutants, Organic compounds, Microorganisms, Heavy metals, Dissolved solids, Pathogens, Cost-benefit analysis.

A literature review was conducted to critically evaluate the landfilling of wastewater treatment plant (WTP) residuals. Current practices, adverse environmental and public health impacts, beneficial uses, available control technology and management options are described and evaluated. Existing literature revealed a lack of information regarding interature reveaued a fack of information regarding the environmental and public health impacts relat-ed to WTP residual landfilling. Epidemiological information regarding the effects of WTP residual landfilling was absent. WTP residual/refuse co-disposal and sludge-only narrow trench alterna-tives represent the most environmentally acceptable of the landfilling methods. For the most part able of the landfilling methods. For the most part, co-disposal practices pose greater environmental and public health risks than conventional municipal refuse landfills. Depending on the residual treatment, the contaminants include organics, heavy metals, nitrate, pathogens, and dissolved solids. They may be controlled by appropriate treatment and by landfill management. Apart from organic and microbiological components, leachates from WTP residual landfills (alone or condisposal) from WTP residual landfills (alone or co-disposal) are not unlike municipal refuse landfill leachates. It is apparent that the practice of residual disposal in municipal refuse landfills is not only cost-effective, but can be properly managed to provide protection of the environment and public health. (Brambley-W81-03634

LEACHATE AND GAS FROM MUNICIPAL SOLID WASTE LANDFILL SIMULATORS, SCS Engineers, Covington, KY.
For primary bibliographic entry see Field 5B. W81-03635

CONTAINMENT OF HEAVY METALS IN LANDFILLS WITH LEACHATE RECYCLE, Georgia Inst. of Tech., Atlanta. School of Civil

Engineering. For primary bibliographic entry see Field 5B. W81-03640

CADMIUM IN FOLIAGE ALTERS PLANT RE-SPONSE TO TOBACCO MOSAIC VIRUS, New Jersey Agricultural Experiment Station, New

R. Harkov, and E. Brennan.

Journal of the Air Pollution Control Association, Vol 31, No 2, p 166-167, February, 1981. 4 Tab, 20

Descriptors: \*Cadmium, \*Land disposal, \*Phytotoxicity, Plant pathology, Plant growth, Plant viruses, Viruses, Sludge disposal, Wastewater disposal,

The impact of cadmium occurring in fields where sewage sludge had been applied was examined. Specifically, the effect of low levels of Cd on the

development of tobacco mosaic virus (TMV) in bean and tobacco plants was studied. Bean seedings were placed in plastic pots and fed a nutrient solution containing Cd at 0, 0.50, 0.75, or 2.0 micrograms per milliliter as CdCl2 daily. Tobacco seedlings were transplanted to pots and treated with a complete nutrient solution similarly containing Cd as CdCl2. The Cd concentration in bean foliage was a function of the Cd concentration of the nutrient solution. When the foliar content exceeded 14.8 micrograms per gram the plants exceeded 14.8 micrograms per gram the plants exthe nutrient solution. When the tonar content ex-ceeded 14.8 micrograms per gram, the plants ex-hibited symptoms of toxicity due to Cd. The tobac-tox experiment using the Samsun NN cultivar showed that Cd concentrations in tobacco foliage were dependent on the Cd concentration in the nutrient solution. Even when the Cd concentration was as high as 254 micrograms per gram, no visible toxic symptoms were noted. The number of local lesions attributable to TMV at 0.75 and 2.0 microrestons attrioutable to IMV at 0.75 and 2.0 micrograms per milliliter treatments increased significantly over the plants without Cd. No evidence of an interaction between Cd treatment and TMV was noted. (Baker-FRC)

RE-UTILIZATION OF MUNICIPAL WASTEWATER SLUDGES - METALS AND NI-

WASIEWALER SLUDGES TREATH,
California Univ., Riverside.
A. C. Chang, A. L. Page, and F. T. Bingham.
Journal of the Water Pollution Control Federation,
Vol 53, No 2, p 237-245, February, 1981. 9 Tab, 33

Descriptors: \*Land disposal, \*Sludge disposal, \*Trace metals, Crop yield, Waste disposal, Landfills, Soil amendments, Nitrogen, Soil contamination, Heavy metals, Phytotoxicity, Cadmium, Hydrogen ion concentration, Public health, Nitrate, Land application, Agriculture.

The most commonly practiced method of municipal waste water sludge disposal or reuse in the United States is land application. The potential impact of trace metal elements associated with land reutilization of waste water sludges was evaluated in field and laboratory tests. Results showed that nitrogen and heavy metals, especially cadmium, are most likely to limit cropland reception of sludges. In sludge-treated soils, there is a potential for heavy metals to accumulate through repeated applications to levels that may become phytotoxic. Consumers may be exposed to elevated levels of potentially hazardous trace metals even before detpotentially hazardous trace metals even before derimental effects to crops are detected. The accumulation of cadmium, zinc and nickel is governed largely by soil pH. When soils become acidic, these elements present in sludge could seriously reduce crop yields. Under carefully controlled soil conditions, repeated sludge application may be utilized without damage to crops. (Geiger-FRC) W81-03758

EXPERIENCES WITH RUNOFF CONTROL SYSTEMS IN INDIANA,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5B. W81-03771

APPLYING SLUDGE AT AGRONOMIC

Ohio State Univ., Columbus. Dept. of Agricultural Engineering. R. K. White, and R. E. Brown. BioCycle, Vol 22, No 1, p 20-24, January/February, 1981. 7 Tab, 2 Ref.

Descriptors: \*Sludge, \*Land application, \*Farm management, Cultivated lands, Land spreading, Slurries, Sludge cake, Ohio.

Most of the land application systems in Ohio are Most of the land application systems in Onio are applying sewage sludge as slurry to cropland. De-fiance, Lima, Clermont County, and Medina County all successfully utilize slurry systems. While the city of Defiance has publicly owned farm land, the other three truck their slurry to farmer owned land. Clermont County uses rotating biological dices to treat its wastewater while the biological discs to treat its wastewater, while the

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

# Ultimate Disposal Of Wastes-Group 5E

other three use activated sludge. The four cities all have educational programs to inform citizens and farmers. Also, most municipalities have to institute an industrial clean-up program to reduce the heavy metals concentrations in the sludge. Trained personnel haul and apply the sludge. Timing of application is coordinated to enable efficient utilization of fertilizer nutrients as well as to meet the cities' disposal needs. Toledo and Columbus have sludge cake application systems. In the Toledo area, 50 farmers in four counties within a 35 mile radius of tarmers in four counties within a 35 mile radius of the treatment plant provide approximately 2000 acres per year of land for sludge application. In Columbus, 23 farms receive sludge. The sludge cake is allowed to dry before incorporating it into the soil. (Small-FRC) W31-03818

COLUMBUS AERATION SYSTEM USES DRAINAGE TUBING.
BioCycle, Vol 22, No 1, p 31, January/February,

Descriptors: \*Composting, \*Aeration, Sludge bulking, Biological treatment, Sludge, Tubes.

bulking, Biological treatment, Sludge, Tubes.

Perforated plastic drainage tubing was first used to aerate composting sludge during a 1971 study at Beltsville, Maryland. The tubing had been originally installed as under-drains at that site. The tubing has most recently been used at the Columbus, Ohio Southwesterly Wastewater Treatment Plant. Here, grid systems of perforated tubing 16 feet by 134 feet are laid out on a concrete pad. A base layer of wood chips gives higher air permeability by covering the grid. Sludge mixed with wood chips is piled on this base. The sludge pile is covered with a layer of finished compost for insulation and odor control. Air is drawn down through the pile by an exhaust blower attached to the grid. This maintains an oxygen level in the pile of 5 to 15% and reduces moisture content. The blower operates about 4 out of every 20 minutes. After 21 days the pile is torn down by a front-end loader and moved to a curing pile. Because the tubing is relatively inexpensive, it is replaced each time. If unloading is performed slowly and carefully, the tubing can be saved for reuse. (Small-FRC)

COMPOSTING SEWAGE SLUDGE IN PUERTO RICO,

E and A Environmental Consultants, Inc., Sharon, MA.

J. E. Alpert, W. Taffel, and E. Epstein. BioCycle, Vol 22, No 1, p 25-30, January/February, 1981. 2 Fig, 17 Tab.

Descriptors: \*Composting, \*Feasibility studies, \*Sludge, Marketing, Site selection, Pilot plants, Estimated costs, \*Puerto Rico.

A study on the feasibility of using composting to process sewage sludge before its final disposal in Puerto Rico is reported. Phases of the study in-cluded preliminary data collection, pilot composting trials, compost market/utilization studies, and economic data collection. The trials demonstrated economic data collection. The trials demonstrated that sludges of this region can be successfully composted, whether they are dry or wet, digested or raw. Bulking agents can be used to obtain the desired aeration properties. The economic analysis evaluated six different dewatering alternatives, four siting alternatives, and three management options. Annual costs of compost scenarios ranged from \$77,165 to a high of \$268,000. It costs about \$18.08/cu m of sludge to compost the material. Of this cost, 37.5% is related to dewatering the material. Landfilling, incineration and ocean dumping were judged not suitable for future use. (Small-FRC) W81-03820

SEASONAL GROWTH AND ACCUMULATION SEASONAL GROWTH AND ACCUMULATION OF NITROGEN, PHOSPHORUS, AND POTAS-SIUM BY ORCHARDGRASS IRRIGATED WITH MUNICIPAL WASTE WATER,

Cold Regions Research and Engineering Lab., Hanover, NH. For primary bibliographic entry see Field 3C. W81-03828

INTERACTION BETWEEN HIGH LEVELS OF APPLIED HEAVY METALS AND INDIG-ENOUS SOIL MANGANESE, Science and Education Administration, Beltsville, MD. Fruit Lab. For primary bibliographic entry see Field 3C. W31-03829

AND SPREADING OF SEWAGE SLUDGE,

J. F. P. Engelbrecht. Civil Engineer in South Africa, Vol 22, No 12, p 405, 407, December, 1980.

Descriptors: \*Land disposal, Sludge, \*Sludge disposal, Sewage bacteria, Wastewater disposal, Heavy metals, Plant growth, Bacteria, Diseases, Microorganisms, Seepage, \*South Africa.

Currently in South Africa much of the sewage sludge is disposed of by land application. The rapidly increasing industrialization of society in the area is causing an increased concentration of heavy metals and other toxic substances in this sludge metals and other toxic substances in this sludge. Studies are being made of any possible harmful effects to plants, animals, and people from the presence of these substances on the land. The microbiological quality of the seepage in the soil-sludge is also being monitored to establish the distribution and movement of bacteria in the soil distribution and movement of bacteria in the soil and in plants. Experiments using lysimeters and small plots of land are being carried out also. Five levels of sludge application were made to test plots on which vegetables were grown. Analyses for chemicals and microbiological findings are being carried out on dried, digested sewage sludge, the soil in the lysimeters and the soil in the beds, and the harvested plant material. After a period of one year no relationships have been established between the level of sludge application and the concentration of heavy metals in the seepage. As of yet no evidence has been found regarding contamination of plants or seepage by the addition of dried, digested sewage sludge. Research will continue on this project for a total of five years, beginning in 1978. (Baker-FRC)

DEEP WELL INJECTION: A VIABLE ALTER-NATIVE TO OCEAN OUTFALLS, Water Well Journal, Vol 34, No 3, p 56-58, March,

Descriptors: \*Deep wells, \*Injection wells, Waste disposal, Capital costs, Operating costs, Municipal wastewater, Coastal aquifers, \*Florida, \*Wastewater disposal.

In Florida, deep well injection is gaining attention as a means of sewage disposal other than ocean outfall. Florida's natural underground formation of limestone and dolomite together with a 1000 ft confining stratum provide the conduit and an impermeable barrier to prevent the effluent from polluting groundwater. A 95% treated effluent is pumped into caverns in the limestone/dolomite zone at a rate of 10,000 gallons per minute. It seeps through the upper and lower Florida Aquifer and ultimately to the Alantic Ocean. With this method, there is no beach pollution. Also, bluefish have been seen in the intercoastal waterway for the first time in years. Deep well injection is one-tenth as costly as ocean outfall to install and only one-hundredth as costly to maintain. Deep well injecas costly as ocean duttain to listan and only offi-hundredth as costly to maintain. Deep well injec-tion is successful in several Florida communities: West Palm Beach, Sarasota, St. Petersburg, and Vero Beach. (Small-FRC) W81-03885

DISAPPOINTMENT OF THE SEVENTIES, EX-PECTATIONS OF THE EIGHTIES, Weston (Roy E.), Inc., West Chester, PA. A. W. Breidenbach, P. B. Lederman, and R. B. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 152-154, February, 1981.

Descriptors: \*Solid waste disposal, \*Water pollu-tion prevention, Water quality management, Land-fills, Leaching, Waste disposal, Public health, \*Waste management, Management planning, Groundwater pollution.

Hazardous and nonhazardous wastes may be viewed as a product of society and its demands. In the last half century, many advances have been made in providing for the material needs, comfort, and well-being of society. As a result of this standard of living more wastes have been generated and must be managed. Past theories of planning generally paid little attention to the consequences of waste disposal on land. The leaching of harmful substances from landfill sites often caused contamination of groundwater. In the late 1960's concern substances from landfill sites often caused contamination of groundwater. In the late 1960's, concern with public health and esthetics increased, and more sophisticated methods of environmental analysis were developed. In the past, wastes have generally been disposed of in the solid form, but new methods are rapidly changing this situation. It is suggested that progress can be made in the 1980's if the knowledge gained from past mistakes is utilized. (Geiger-FRC) W81-03896

OCEAN DUMPING OUT - WET AIR TREAT-MENT IN, M. Garbrecht.

Consulting Engineer, Vol 56, No 3, p 134, 136, March, 1981.

Descriptors: \*Wet air oxidation, \*Sludge disposal, Treatment plants, Wet oxidation process, Munici-pal wastes, Ocean dumping, New Jersey.

A wet air oxidation facility is under construction in Northern New Jersey to replace the ocean dump-ing of 600,000 tpd of sewage sludge. The facility will sterilize the sludge, reduce its volume, and break up the gelatinous composition which makes the sludge difficult to dewater. A third phase of the sludge difficult to dewater. A third phase of the project will replace an existing primary treatment works with new primary clarification equipment. Between 575 and 787 tpd of sewage solids will go to a battery of 12 wet oxidation units. Heat exchangers will transfer heat from the outgoing sludge flow to preheat the feed. Thus the units can operate without outside steam once the operating temperature is reached. Sludge filter cake will be stockpiled until a combustion plant is operational. Much of the new facility will be underground. (Small-FRC)

BACTERIAL BED CONSUMES PHENOL,

D. Dempster. Canadian Chemical Processing, Vol 65, No 1, p 36-37, February 13, 1981.

Descriptors: \*Phenol, \*Bacteria, \*Fuel, Synthetic fuel industry, Industrial wastes, Wastewater treatment, Microorganisms, \*Waste disposal.

A major disposal problem for the synthetic fuel (synfuel) industry has been phenol, which is produced during the production of synthetic fuels from coal feedstocks. Phenol is an extremely corrosive substance, and can contaminate drinking water supplies when discharged into rivers and streams. The current treatment of phenol calls for its the areast through sudges extirated with Passes. it to be passed through sludge activated with Pseudomonas to render it environmentally safe. This domonas to renner it environmentary sate. This process is messy, expensive, and requires huge tanks of sludge. A special strain of bacterium is being studied, as it appears to consume the phenol. By exposing the waste to colonies of Pseudomonas which are attached to inert particles, the removal approcess is made much simpler cheaper and essier which are attached to hiert particles, the elemonar process is made much simpler, cheaper and easier to handle. The mixture of inert pellets and wastewater forms a semi-fluidized bed, with the wastewater forms a semi-fluidized bed, with the upper section in agitation and the lower section compact. The effective bacterial action takes place in the packed part of the bed, at the bottom. (Baker-FRC)

PLOW SLUDGE UNDER, Dallas City Water Utilities Dept., TX. L M. Rice. Water and Wastes Engineering, Vol 17, No 9, p 60, 62, 64, 65, 67, 68, September, 1980. 2 Fig, 6 Tab.

Descriptors: \*Sludge disposal, \*Soil amendments, \*Dredging, Lagoons, Wastewater treatment, Disposal, Ultimate disposal, \*Dallas, Texas.

# Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

# Group 5E-Ultimate Disposal Of Wastes

Plowing sludge into the ground has proved effective during three years of study by the Dallas, Texas, waste water treatment plant. Digested sludge dredged from lagoons was injected beneath the soil surface by tractors. The operation is weather dependent; application cannot be done when the ground is wet. To dispose of 100 tons per day produced by the plant, a redundancy in equip-ment and personnel is necessary to take advantage ment and personnel is necessary to take advantage of favorable days. A total area of 500 acres is projected. To date the best application rate was 48 dry tons of sludge applied the week of June 17, 1979, compared with 644 dry tons of sludge produced. No significant change in groundwater quality was detected between Fall 1978 and Spring 1990 (Ocease PDC) 1980. (Cassar-FRC)

PROBLEMS PLAGUE HAZARDOUS WASTE

DISPOSAL, Wei (Norman S.) and Associates, Ltd., Toronto

Water and Wastes Engineering, Vol 17, No 2, p 54, 56, February, 1980.

escriptors: \*Waste disposal, \*Chemical wastes, \*Hazardous wastes, Costs, Industrial wastes, Land-fills, Social aspects, Disposal, Great Lakes, Politi-cal aspects, Water pollution sources, Governments, Ultimate disposal.

Establishment of hazardous waste disposal sites is Establishment of hazardous waste disposal sites is hampered by community resistance, inadequate facilities, and lack of funds. Several case studies illustrate these difficulties. The Minnesota Pollution Control Agency had to return a \$3.7 million grant to EPA after the public strongly opposed four proposed sites for a chemical waste landfill. In Ontario a private waste disposal firm was refused permission to operate a disposal site after 43 public hearing sessions. Although test incineration of PCBs in Mississauga, Ontario, destroyed 99.8% of the material, local residents blocked further burnaria. ing. The wastes are currently being stored. A similar situation occurred in Detroit. Agreement on the environmental hazards of industrial wastes, benefits of industrial development, and the govern-ment's role must be reached among all parties concerned--industry, public, and government. (Cassar-FRC) W81-03947

# 5F. Water Treatment and **Quality Alteration**

A STUDY TO IDENTIFY THE POTENTIAL OF NATURALLY OCCURRING ZEOLITES FOR REMOVING HEAVY METALS FROM WATER, Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.

Mineral Engineering.
M. J. Semmens.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-215667,
Price codes: A08 in paper copy, A01 in microfiche.
Minnesota Water Resources Center, University of
Minnesota Project Completion Report, March 31,
1981. 162 p, 84 Fig. 21 Tab, 28 Ref. OWRT-B-150MINN(1), 14-31-0001-5013.

Descriptors: "Zeolites, "Heavy metals, "Water treatment, "Water quality, "Water pollution control, Water pollution, Copper, Cadmium, Trace elements, Impaired water quality, Water quality control, Quality control, Adsorption, Uptake, Pollution load, Environmental protection, Population exposure, Water pollution treatment, Pollution prevention. Pollutants

Extensive studies were conducted to characterize the heavy metal (cadmium (Cd) and copper (Cu) removal behavior of clinoptilolite (CL)). Acidic or alkaline pretreatment of CL appeared to increase its capacity, as measured by sodium displacement by potassium. Calcium was found to be a major competing cation for Cd and Cu exchange by CL, and was difficult to displace from CL entirely. Isotherm studies at two CL particle sizes showed no significant difference in metal behavior, indicating exchange was not a surface-controlled reaction. Column tests (using CL and synthetic strong/ weak acid resins) for Cd and Cu removal, designed from batch isotherm study results, were conducted to identify the effect of several parameters on metal removal performance. Column results using metal removal performance. Column results using alkaline-pretreated (one molar NaOH for a day) CL showed excellent agreement with the batch isotherm data. Regeneration of Cd-laden CL showed a rapid initial Cd release was observed unless NaCl was added. Regeneration of the Cd-laden synthetic resins could be accomplished completely and the extended tailing of Cd release seen with Cd-laden CL did not occur. (Zielinkski-IPA) W81-03608

CORROSION INHIBITION, Petrolite Corp., St. Louis, MO. (Assignee).

Petrolite Corp., St. Louis, and Communication, F. J. Hartte. U.S. Patent No. 4,212,842, 8 p., 3 Fig. 3 Tab, 12 Ref. Official Gazette of the United States Patent Office, Vol 996, No. 3, p. 1031-1032, July 15, 1980.

Descriptors: \*Patents, \*Water treatment, \*Water quality control, \*Corrosion control, Industrial water, Recycling, Sea water, Chemical reactions.

A method of inhibiting corrosion in an aqueous system including fresh water, brine, sea water, etc., comprises adding an aqueous insoluble corrosion inhibitor which in salt form is soluble, the pH of the aqueous system being sufficient to hydrolyze the salt so as to disperse the insoluble corrosion inhibitor itself as fine droplets which coat the metal with the control of the co with a corrosion inhibiting film. It has now been discovered that salts of such heterocyclic amines make excellent corrosion inhibitors when employed in aqueous systems having a pH above and about 6. When such heterocyclic amine salts are dissolved in aqueous systems having a pH in excess of about 6, hydrolysis of the salt takes place and the heterocyclic amine itself comes out of solution and necessary amme usen comes out of solution as a very fine dispersion which coast the metal to be protected with a uniform tenacious corrosion inhibiting film. (Sinha-OEIS) W81-03667

FILTER, Universal Water Systems, Inc., Chicago, IL. (As-

signee).

A. Van Meter, and W. J. Gartner.

U.S. Patent No 4,212,743, 7 p, 6 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 1008, July 15, 1980.

Descriptors: \*Patents, \*Water treatment, \*Water quality control, Filtration, Filters, Odor, Taste, Domestic water, Activated carbon

A filter cartridge for use in filters or water filters particularly, includes an inlet for water to be puri-fied and an outlet for filtered water. Partitions within the cartridge define an elongated, tortuous water flow path between the inlet and outlet. Filter pads and activated carbon, or another suitable absorbent material, is disposed in the flow path. The cartridge of this invention provides effective odor and taste filtering of the water because the water passes over a large area of filter surface as it travels from the inlet to the outlet. (Sinha-OEIS) W81-03668

DESTRUCTION METHOD FOR THE WET COMBUSTION OF ORGANICS. Hydroscience, Inc., Emerson, NJ. (Assignee).

R. A. Miller. U.S. Patent U.S. Patent No 4,212,735, 5 p, 3 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 1005, July 15, 1980.

Descriptors: \*Patents, \*Water treatment, \*Industrial water, Organic wastes, Oxidation, Catalysts, Chemical reactions, Hydrogen ion concentration.

The method of oxidizing organic compounds, such as 1,3,5-trichlorobenzene, in an aqueous system of pH not more than about 4 is described. The method comprising oxidizing the organic compound by contacting the compound with an oxidizing agent, such as air, in the aqueous system in the presence of a catalytic amount of a cocatalyst system, is improved by using as the cocatalyst system a catalytic combination of nitrate ions. At least one of either bromide ions or iodide ions, and transition metal ions of at least one transition metal has two or more oxidation states, such as vanadium ions. This cocatalyst system enhances the rate of oxidation of the organic compounds. (Sinha-OEIS) W81-03669

INHIBITING SCALE WITH AMINO-PHOS-PHONIC-SULFONIC ACIDS, Petrolite Corp., St. Louis, MO. (Assignee). D. Redmore, and F. T. Welge. U.S. Patent No 4,212,734, 8 p, 3 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 1005, July 15, 1980.

Descriptors: \*Patents, \*Water treatment, \*Scaling, \*Demineralization, Inhibition, Chemical reactions, Oxides, Inhibitors.

The invention relates to compounds characterized by the presence of N-methyl, or substituted methyl, phosphonic acid and N-propylenesulfonic acid groups. These compounds contain at least one or more of each group and are bonded to the same or different amino groups. They are derived by reacting an amine with both propane sultone and with a carbonyl compound, such as formaldehyde, and phosphorous acid or its equivalent. A process for inhibiting scale comprises employing threshold amounts of the compositions of this invention. In general it is preferred that at least 50% but preferably at least 80% of the nitrogen-bonded hydrogens of the polyamine be replaced by solfonate or phosphonate groups. Scale formation from aqueous solutions containing an oxide variety of scale forming compounds, such as calcuim, barium and magsolutions containing an oxide variety of scale forming compounds, such as calcuim, barium and magnesium carbonate, sulfate, silicate, oxalates, phosphates, hydroxides, fluorides and the like are inhibited by the use of threshold amounts of the composition of this invention which are effective in small amounts, such as less than 100 ppm and are preferably used in concentrations of less than 25 ppm. (Sinha-OEIS) W81-03671

METHOD OF AND APPARATUS FOR TREAT-ING WATER,

U.S. Patent No 4,211,649, 6 p, 6 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 996, No 2, p 620, July 8, 1980.

Descriptors: \*Patents, \*Water treatment, \*Domestic water, Metals, Separation techniques, Filtration, Activated carbon, Equipment.

A housing or porous water-permeable material containing granular water-treatment particles is immersed in a quantity of water, and means are provided for effecting circulation of the water through the housing whereby certain chemicals are removed from the water. The device utilizes a metered quantity of one or materials which have been selected to remove certain specific products. been selected to remove certain specific products from the water, and after this material has been used once, or at the most several times, it is dis-carded thereby preventing the growth of undesira-ble bacteria. (Sinha-OEIS) W81-03680

ACTIVATED OXYGEN PRODUCT WATER TREATMENT USING SAME,

A. J. Pincon.
U.S. Patent No. 4,214,962, 9 p, 7 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol. 996, No. 5, p. 1784, July 29, 1980.

Descriptors: \*Patents, \*Water treatment, \*Water purification, \*Irradiation, \*Oxygen, Properties, Surface tension, Disinfection, Desalination, Activated oxygen.

An activated oxygen product is produced by irra-diating oxygen with electromagnetic radiation of wavelength less than 200 nonometers, and having an unusually high oxidation potential and unique spectral properties. The product may be used to treat water in order to reduce surface tension,

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

# Water Treatment and Quality Alteration—Group 5F

oxidize wastes, reduce manganous ion concentra-tion, and disinfect water without creating carcino-gens. The product obtained by irradiation of oxygen or air is an activated form of oxygen, the precise chemical identity of which is not yet known. However, the product can be identified by its properties, which also serve to demonstrate its novelty. The product is negatively charged. (Sinha-OEIS)

WATER COLLECTING AND DISTRIBUTING APPARATUS DISPOSED IN A LOWER POR-TION OF HIGH SPEED FILTER BASIN, Mitsui Shipbuilding and Engineering Co. Ltd.,

Mitsui Shipbuilding and Engineering Co. Liu, Tokyo (Japan). K. Sasano, and I. Shiramasa. U.S. Patent No 4,214,992, 6 p, 5 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 996, No 5, p 1793, July 29, 1980.

Descriptors: \*Patents, \*Water treatment, \*Water quality control, \*Filtration, Filters, Flow control, Aeration, Equipment, Backwashing.

According to the water collecting and distributing apparatus of the invention, which is disposed in a lower portion of a filter basin, not only collection of filtered water or filtrate and distribution of raw of filtered water or filtrate and distribution of raw water or back wash water but also dispersing of scouring air can be accomplished. For attaining this, a flow passage for water and air and a water dispersing chamber are formed in blocks placed in the lower portion of the filter basin and appropriate holes are formed in the partition wall between the flow passage and dispersing chamber and the top walls of the flow passage and dispersing chamber in each block. The flow passage is formed to have a trapezoidal sectional shape in each block. (Sinha-OEIS)

PURIFYING PLANT FOR WATER TO BE VA-PORIZED IN A STEAM GENERATOR OF A NUCLEAR REACTOR, Kraftwerk Union A.G., Muelheim an der Rhur

(Germany, F.R.).

H-G. Heitmann. U.S. Patent No 4,216,057, 4 p, 1 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 211, August 5, 1980.

Descriptors: \*Patents, \*Water treatment, \*Water quality control, \*Water purification, Industrial water, Filters, Ion exchange, Recycling, Steam turbines, Nuclear powerplants, Nuclear wastes, \*Electromagnetic filters.

A purification system for water to be vaporized in a steam generator of a nuclear reactor having a feedwater circulatory loop includes an electromag-netic filter having an inlet and an outlet connected in the feedwater circulatory loop, a line branching from the feedwater circulatory loop downstream of the electromagnetic filter in direction of feed-water flow, and an ion exchange filter connected in the line. An objective of such a purifying plant is to exclude ion oxide deposits as much as possible from the steam generating system. The continuous operation as well as the periodically required rinsing operation for purifying the filter bed can be effected with a minimum of additional plant components provided for the purification operation. (Sinha-OEIS) W81-03701

#### PROCESS FOR CLARIFYING WATER,

J. L. Land. U.S. Patent No 4,216,086, 5 p, 8 Tab, 12 Ref, Official Gazette of the United States Patent Office, Vol 997, No 1, p 218, August 3, 1980.

Descriptors: \*Patents, \*Water treatment, \*Water purification, Water quality control, Suspended solids, Flocculation, Separation techniques, Recycling, Polyvalent cations

The use of fusion-formed compounds of polyvalent cations with aluminate, alumino-borate and -ferrite anions has been found to provide improved clarifi-

cation methods for settling aqueous suspensions of solids. The use of these materials has been found to be more effective than the use of the corresponding conventional mono-valent cation compounds. ing conventional mono-valent cation compounds.

A particularly effective form of these clarifying agents is obtained when the preparation is carried out by high temperature methods, which brings about the incipient or actual fusion of the materials. Recycling of the once-used clarifying agents is possible when using these materials, especially when the flocculated solids are incinerated during the ultimate disposal step. The process produ astisfactorily clear supernatent portion which may be easily removed as purified water, thus greatly increasing the overall capacity of existing water purification installations. (Sinha-OEIS) W81-03704

SCRUBBER SCALE PREVENTION, Dow Chemical Co., Midland, MI. (Assignee). R. S. Long, and J. B. Siemak. U.S. Patent No 4,216,087, 3 p, 11 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 218, August 5, 1980.

Descriptors: \*Patents, \*Water treatment, \*Scaling, Industrial water, Inhibition, Inhibitors, Calcium, Recirculated water, Scrubbers.

It has been discovered that a concentrated sodium It has been discovered that a concentrate sodium hydroxide solution containing a calcium inhibitor having a high degree of solubility can be employed in the gas scrubbing of SO2-containing flue gases to maintain the requisite alkalinity and to control or prevent undesired calcium scaling. The method comprises contacting the flue gas in a scrubber with a calcium-containing aqueous stream mixed with as expectations contained to the control of the control with a calcium-containing aqueous stream mixed with an aqueous solution comprising a concentrated sodium hydroxide and a 2-hydroxyethyl iminodiacetate calcium inhibitor being used in a sufficient amount to maintain the pH of the aqueous stream between about 5.5 and about 7.5. (Sinha-OEIS). W81-03705

EXPANDING COMPUTER APPLICATIONS TO REDUCE ENERGY CONSUMPTION, Greeley and Hansen, Philadelphia, PA. H. D. Gillman.
Journal of the American Water Works Association, Vol 73, No 3, p 140-143, March, 1981. 8 Fig. 8 Perf

Descriptors: \*Digital computers, \*Electric power demand, \*Treatment facilities, Electric power costs, Data processing, On-site data collections,

Although digital computer systems may be primarily assigned to data processing, displays, and controls for treatment functions, the computer can also provide continuous displays of energy and power provide continuous displays of energy and power usage to assist the treatment plant operator in reducing power and energy demands. The computer can be programmed to calculate and display the energy charge, fuel-adjustment charge, demand charge, and power factor adjustment. Overall energy usage can be reduced by installing energy efficient equipment. The demand charge can be reduced by installing energy. reduced by reducing and smoothing out the demand peaks through proper scheduling of the load. Loads such as pumping into elevated storage can be scheduled for off-peak hours. For a power survey, the computer can sample all the sensed warisbles and store time-tagged tread histories. The variables and store time-tagged trend histories. The CRT (cathode ray terminal) can be used to display a plant process graphic. For example, a section of the plant switch-gear can be displayed, showing the status of all circuit breakers. Microprocessor-based monitors and controllers of energy are now on the market. (Small-FRC)

ON THE MARGINAL COST OF WATER

Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics. S. H. Hanke.

Water/Engineering and Management, Vol 128, No 2, p 60-63, 68, February, 1981. 1 Fig, 8 Tab, 7 Ref.

Descriptors: \*Marginal costs, \*Water supply, \*Seasonal variation, Costs, \*Water use, Economic aspects, Utilities, Water rates.

The marginal costs for the Spring Valley Water Company were calculated using the concepts de-veloped by Turvey. First, the permanent incre-ments in water use over a time period were estimated. Then, investments required to meet the growth in water use were forecast. For Spring Valley, these investments are tribed to Valley, these investments entailed the construction of a reservoir and the associated transmission and water treatment facilities. Using a real, inflation-free rate of interest of 8.5%, marginal costs were calculated to be \$53.45/100 cu ft. If instead of calculated to be \$33.49/100 cti it. It instead on averaging marginal costs over the entire year, costs are calculated for a winter and a summer season, the annual winter marginal cost was \$33.93/1000 cu ft and the annual summer marginal cost was \$76.52/1000 cu ft. Simulation with annual marginal cost rates or seasonal marginal costs rates can indicate whether new investments in the sys-tem's capacity are justified and whether sufficient tem's capacity are justified and whether sufficient revenues will be generated in the coming year. A seasonal change in the price of water could be used. A full-scale simulation of marginal cost-rate structure and an investigation of its impacts is recommended. (Small-FRC) W81-03793

IMPACT OF EXPANDING REGULATORY CLI-MATE ON WATER UTILITY FINANCING PROGRAMS,

Water/Engineering and Management, Vol 128, No 2, p 57-58, February, 1981.

Descriptors: \*Economic aspects, \*Construction costs, \*Treatment facilities, Alternative planning, Nonstructural alternatives, Water conservation, Water distribution, Water rates.

Before implementing a capital improvements program, water system managers must consider environmental considerations, population shifts, a growing conservation movement, taxpayer revolts, and an inflationary economy. Advance planning may save money. A reevaluation of existing capacity may save money. A recvaluation of existing capacity may reveal some less expensive solutions to capacity or treatment problems. A conservation program may reduce future needs to a level that can be handled by the current system, or modular design may make expansion less expensive. Even design may make expansion less expensive. Even though it may be economically prudent to con-struct new or expanded facilities when the con-struction index is rising faster than interest rates, different financing techniques can be used. A combination of revenue bonds and current revenue may be most effective. During times of high inter-est rates, the mix of the two should be heavily in favor of current income. It is best if water rates can be adjusted annually to meet costs. The possibility of a federally guaranteed loan for a federally mandated project should be considered. (Small-FRC) W81-03795

ONE APPROACH TO COMPUTERIZED OP-ERATION, Dallas City Water Utilities Dept., TX.

For primary bibliographic entry see Field 7A. W81-03797

THE COMPUTER AS A TOOL FOR MEETING FUTURE DEMANDS.

Atlanta Bureau of Water, GA. For primary bibliographic entry see Field 7A. W81-03798

CONTROLLING TRIHALOMETHANES WHILE ATTAINING DISINFECTION, Environmental Protection Agency, Washington,

DC. C. Vogt, and S. Regli.

C. Vogt, and S. Regin. Journal of the American Water Works Associ-ation, Vol 73, No 1, p 33-40, January, 1981. 2 Fig, 7 Tab, 29 Ref.

Descriptors: \*Trihalomethanes, \*Potable water, \*Disinfection, \*Water treatment, Water pollution

# Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

# Group 5F-Water Treatment and Quality Alteration

sources, Carcinogenesis, Chlorination, Chemical reactions, Ozone, Chloramines, Chlorine dioxide, Microbiology, Water pollution control.

Regulations requiring control of trihalomethanes (THMs), especially chloroform, in drinking water are discussed, and control alternatives are analyzed. Regulations finalized by EPA on November 29, 1979, set forth a maximum contaminant level of 0.10 mg/l for total THMs, and require monitoring and reporting of THM levels at quarterly intervals. Control strategies include use of a disinfectant that, unlike chlorine, does not generate THMs (chlora-mines, chlorine dioxide, ozone), reduction of THM precursors prior to chlorination, or reduction THMs after formation. By 1977, ozone was the perferred disinfectant in more than 1039 water treatment plants, mostly in Canada and Europe. Ozone is a more effective disinfectant than chloozone is a more effective distinectant than cine-rine, does not produce THMs, and can also be used to remove THM precursors prior to conventional chlorination. Precursors can be removed by direct chlorination. Precursors can be removed by direct rezonation or by using ozone to improve the removal efficiency of coagulation, settling, or filtration units. A summary of data from pilot studies showing THM precursor removal efficiencies of up to 80% is presented. Disadvantages of ozone compared to chlorine include limited residual disinfectant protection (sometimes leading to aftergrowth problems), higher costs, and the potential for forming organic byproducts with unknown health risks. Consideration of ozone's ability to remove THM precursors while improving the efficiency of other unit processes is likely to reduce its price disadvantage. (Robinson-FRC)

COMPARISON OF THE BIOCIDAL EFFICIEN-

CUMPARISON OF THE BIOCIDAL EFFICIEN-CY OF ALTERNATIVE DISINFECTANTS, Environmental Protection Agency, Cincinnati, OH. Microbiological Treatment Branch. J. C. Hoff, and E. E. Geldreich, Journal of the American Water Works Associ-ation, Vol 73, No 1, p 40-44, January, 1981. 8 Fig. 2 Tab. 14 Ref.

Descriptors: \*Disinfection, \*Potable water, \*Microbiology, Kinetics, Chemical reactions, Ozone, Chlorine dioxide, Chloramines, Chhorination, \*Water treatment, Viruses, Bacteria, Escherichia coli, Trihalomethanes, Hydrogen ion concentration

Laboratory and field studies of the biocidal efficiencies of free residual chlorine, ozone, chlorine dioxide, and chloramines in drinking water are reviewed. Disinfection rates are compared in terms of the times and concentrations required to achieve a specified degree of inactivation (e.g., 99%) of a given microorganism. Overall, ozone is the most efficient and least stable agent; chlorine dioxide is second in efficiency and stability; free chlorine is third in efficiency and stability, and chloramines are least efficient and most stable. Inactivation are least efficient and most stable. Inactivation kinetics for E. coli, poliovirus I, cell debris-associated poliovirus, and coliform bacteria are graphed for all the agents except ozone, which operates too quickly for convenient plotting. Ozone has been shown to effect greater than 99.999% reduction of E. coli in 10 see at an initial concentration of 0.38 mg/l, and 99.7% reduction of poliovirus 1 in 10 see at only 0.012 mg/l. The biocidal action of ozone and chloramines was only clightly effected. ozone and chloramines was only slightly affected by pH in the pH 6-9 range; that of chlorine de-clined rapidly as pH rose from 7-9, and that of chlorine dioxide rose as pH increased. The effects of particular microorganisms and dissolved salts on biocidal efficiency are also discussed. Laboratory bloccial efficiency are also discussed. Laboratory studies simulating field conditions indicate that turbidity can shield microorganisms from disinfectants: e.g., viruses suspended with cell debris are protected from ozone. There is not yet sufficient information to recommend the replacement of chlorine with other disinfectants. (Robinson-FRC) WSI (AUST)

WHY PRECHLORINATION IS ON THE WAY

K. Grover American City and County, Vol 95, No 9, p 67-68, September, 1980. 1 Fig.

Descriptors: \*Chlorination, \*Water purification, \*Water treatment, Chlorine, \*Raw water, Potable water, Water quality, Chemical reactions, Disin-fection, Odor, Filtration, Organic compounds.

Prechlorination of raw water is a process which disinfects, removes iron, manganese and color, controls, taste, odor, and algae growth, and improves coagulation and filtration in water treatment. Trihalomethane is a contaminant byproduct of the reaction of chlorine with natural materials present in raw water. Alternative methods of water treatment are presented as means of reduc-ing concentrations of trihalomethane or chloro-form and chloroform precursors in water. These torm and colorotorm precursors in water. I nese methods are: (1) Removing the precursors from the raw water by increasing coagulant levels or by adjusting the raw water pH; (2) moving chlorine application to a later stage in the treatment; (3) adding ammonia to react with free chlorine; (4) using an alternative oxidant such as ozone, chlorine dioxide, chloramines, or bromine chloride; or interioration, criticalmines, or oromine chioride; or (5) abandoning prechlorination. Although the final alternative may present operational problems such as cost burdens or fouling in some plants, there is growing interest in the abandonment of prechlorination. (Titus-FRC) W81-03846

EFFECT OF CHLORINE ON GIARDIA LAMB-LIA CYST VIABILITY, Oregon Univ. Health Sciences Center, Portland. Dept. of Microbiology and Immunology. E. L. Jarroll, A. K. Bingham, and E. A. Meyer. Applied and Environmental Microbiology, Vol 41, No 2, p 483-487, February, 1981. 3 Fig. 2 Tab, 23

Descriptors: \*Giardia lamblia, \*Flagellates, \*Human diseases, \*Chlorination, Microorganisms, Diseases, Water quality, Hydrogen ion concentra-Water temperature, Temperature, Cysts,

The effect of chlorine concentration on Giardia lamblia viability was studied with varying temperature, pH, time, and Cl concentration. At low temperature, killing of Giardia required high Cl levels, long contact times, and lower pH. For example, at 5C, 1 mg Cl per liter did not kill all cysts after 60 min at any pH tested. At 1 mg Cl per liter and 10 min exposure, 35% survived at pH 6 and 56% at pH 8. Four mg Cl per liter killed all cysts after 60 min, but not at 30 min. At 25C no cysts survived at Cl concentrations of 1.5 mg per liter or higher for 10 min at pH 6.8. At 15C and pH 6 no cysts survived a 10 min exposure to 2.5 mg Cl per liter; at pH 7, 1.8% survived for 10 min and 0.4% for 30 min. At pH 8 (15C, 2.5 mg Cl per liter) survivals were 2.0 and 0.4% at 10 and 30 min, respectively. When disinfecting water containing respectively. When disinfecting water containing Giardia lamblia cysts, careful attention must be given to pH, Cl concentration, and water temperature. Of these factors, temperature is most importable of these factors, temperature is most impor-tant because cold water reduces the cysticidal effect of the halogen and allows cysts to remain viable longer. In addition, water is cold even in summer in many areas where Giardia epidemics have been reported. (Cassar-FRC) W81-03850

USES OF OZONE IN DRINKING WATER TREATMENT,

Jacobs Engineering Group, Washington, DC. R. G. Rice, C. M. Robson, G. W. Miller, and A. G. Hill.

Journal of the American Water Works Association, Vol 73, No 1, p 44-57, January, 1981. 12 Fig, 4 Tab, 58 Ref.

Descriptors: \*Water treatment, \*Ozone, Disinfection, Oxidation, Potable water, Europe, Canada, History, Chemical treatment, Literature reviews, Design criteria, Costs, Inorganic compounds, Floculation, Separation techniques, Organic compounds, Facilities.

A two-year assessment of the use of ozone to treat drinking water is summarized. The study included questionnaires to plants using ozone in Europe and Canada; on-site inspection of 21 key European

water treatment plants: literature review; and interwater treatment plants; literature review; and inter-views with equipment suppliers, engineers and users. Topics include properties of ozone; the his-tory of ozonation, bacterial disinfection; viral inac-tivation as practiced in France; oxidation of organ-ics, metals, cyanides, sulfides, and nitrites; decom-plexing of organically bound Mn; color, taste and odor removal; algae control; flocculation and mi-teroflocculation; promotion of secopic biological croflocculation; promotion of aerobic biological processes in filter and adsorption media; and the use of ozone to blue water in Germany. Information is also presented on the limits to the ability of ozone to control trihalomethanes before and after formation; post-treatment after ozonation to remove oxygenated organics and ammonia that to bacterial aftergrowth; conditions under which post-treatment is unnecessary; capital and operating costs; public health issues; and ozone hazards and safety measures at treatment plants. (Robinson-FRC) W81-03869

PUBLIC HEALTH ASPECTS OF ALTERNA-TIVE WATER DISINFECTANTS.

California Dept. of Health Services, Berkeley Journal of the American Water Works Association, Vol 73, No 1, p 31-33, January, 1981. 18 Ref.

Descriptors: \*Disinfection, \*Potable water, \*Public health, Ozone, Chlorine dioxide, Chlorina-tion, Chemical reactions, Water pollution effects, \*Water treatment, Oxidation, Human diseases.

Studies of reaction products associated with the use of chlorine dioxide and ozone to purify drinking water are reviewed. Chlorination is known to produce carcinogens, especially trihalomethanes. Chlorine dioxide and ozone destroy pathogens as effectively as chlorine, but their reaction products are not well understood. Ozonation of water does not produce trihalomethanes, and ozone itself does not persist in water. Ozonation of such compounds as 2-propanal, acetic acid, and oxalic acid yields formaldehyde, formic acid, and glyoxic acid, most of which is oxidized to carbon dioxide. Ozonized water has been found to contain aldehydes (n-hexanal, n-heptanal, n-octanal, and n-nonanal) and hydrocarbons (n-hexane, h-heptane, n-octane, and n-nonane). The formation of epoxides and organic peroxides is a strong possibility suggested. One report finds increased skin tumor initiation in mice treated with a concentrate of ozonated river water, and several reports find increased Ames test mutaand several reports that increased Ames test muta-genicity for ozonated water. Health effects of these reaction products, especially the oxidized organic compounds, are uncertain. The same is true of chlorine dioxide, particularly for reactions that produce the chlorite ion. In the light of this uncer-tainty, the substitution of ozone or chlorine dioxide tainty, the substitution of ozone or chlorine dioxide for chlorine in water treatment systems cannot be recommended. The manipulation of chlorination systems to minimize carcinogen formation is pref-erable. (Robinson-FRC) W81-03870

TREATMENT RESTORES ACID WATER,

D. Barr. Water and Sewage Works, Vol 127, No 1, p 29, January, 1980. 1 Fig.

Descriptors: \*Acid mine drainage, \*Acid mine water, \*Groundwater contamination, Water treatment, Coal mine wastes, Treatment facilities, Drinking water, Stream pollution, Chemical treatment, \*Altoona, Pennsylvania, Wastewater treatment.

The city of Altoona, Pennsylvania, had to restore The city of Altoona, Pennsylvania, had to restore its water supply, which was contaminated by drainage from abandoned coal mining operations. The Altoona Acid Mine Drainage Treatment Facility treats water from various contaminated sources. The water from Kittanning Run is polluted to such an extent that the city can no longer use it for producing potable water. This water is treated to remove iron and reduce the acid level. Treated to remove iron and reduce the acid level. Treated water is restured to the servery of the contamination of the contamin ed water is returned to the stream. A second portion of the plant treats water for potable use. Treatment includes iron and manganese removal, reduction of acidity, removal of suspended solids,

# WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

and disinfection. Chemical treatment involves the use of lime, soda, ash, alum, potassium permanganate, coagulant aid, carbon dioxide, and chlorine. The present plant flow, feeding approximately two-thirds of the city's demand, is 4.5 MGD. Plant design capacity is 7 MGD, with plans to expand to 14 MGD. (Small-FRC) W81-03875

GAC VALUE EXCEEDS EXPECTATION, C. Blanck.

Water and Sewage Works, Vol 127, No 1, p 40-42, January, 1980. 1 Fig. 4 Tab.

Descriptors: \*Activated carbon, \*Particle size, \*Adsorption, Performance evaluation, Economic aspects, Water treatment, Organic compounds, Drinking water, \*Davenport, Iowa.

The adsorption capacity of granular carbon for trihalomethanes was found to last for many months at the Davenport, Iowa, water treatment facility. A trihalomethane reduction of 23% and 31% was achieved with activated carbon that had been onachieved with activated carbon that had been online for more than two years and had processed
more than 1 MG/cu ft of settled water. The use of
granular carbon at Davenport has also reduced the
need for chlorination. Specific types of organics
that exhibit chlorine demand are removed by
granular activated carbon. Chlorine feed has been
reduced by 18% over a five-year period. There has
also been a savings in backwash water. Sand is
used as a filter medium, and 15 to 17 Gpm/sq ft of
finished water is needed for backwashing. With
ranular activated carbon. the maximum backgranular activated carbon, the maximum back-washing requirement has been 14 Gpm/sq ft. Re-moval of turbidity has also improved. Davenport officials have estimated that they saved 24% over a two year period using granulated rather than pow-dered activated carbon. The water produced has had a taste-odor effluent threshold number consistently less than one, a tribalomethane concentration of less than 100 ppb, and effectively reduced turbidity. (Small-FRC) W81-03876

ADDITIONAL WATER INCITES COMMUNITY

GROWTH,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
W. K. Neubauer.
Water and Wastes Engineering, Vol 17, No 5, p 60, 61, 63, 64, May, 1980. 3 Tab.

Descriptors: \*Water distribution, \*Water treatment, \*Water supply, Economic impact, Industries, Pumping, Pipelines, Reservoirs, Water purification, \*Onondaga County, New York, Water conveyance, Water storage, Aqueducts, Conveyance

The water treatment, transmission, and storage system started in 1962 by Onondaga County, New York, is nearing completion. The resulting high quality, dependable water supply is responsible for \$300 million of industrial growth, including two large breweires. The system includes provision for economical expansion from 36 to 72 mgd capacity with the water large street of the str without physical expansion of the plant, use of natural freezing/thawing for treatment and dispos-al of waste alum sludges, 70 miles of 36 to 60 inch aqueduct with provisions for doubling the capacity by changing pumping facilities, variable speed direct current motors for pumping, and three major open reservoirs lined with 6 inch asphalt concrete and an underdrain leakage detection system. (Cassar-FRC) W81-03939

INDIRECT WATER REUSE PROBLEMS CAN BE SOLVED AT REASONABLE COSTS, For primary bibliographic entry see Field 5D. W81-03394

ELIMINATE TASTE AND ODOR PROBLEMS CAUSED BY ALGAE, Post, Buckley, Schuh, and Jernigan, Inc., Fort

Nyers, FL. R. R. Wright. Water and Wastes Engineering, Vol 17, No 5, p 67-69, May, 1980. 1 Fig. 2 Tab.

Descriptors: \*Algae, \*Activated carbon, \*Taste, Odor control, Water purification, \*Water treat-ment, Lee County, Florida, Chlorine dioxide, Or-ganic compounds, Potable water, Taste producing algae, Organoleptic properties.

The Lee County, Florida, water treatment plant experienced many consumer complaints about bad taste and odor at the beginning and end of the wet season (May and September). The problems were caused by algae blooms. A granular activated carbon system was chosen to control tastes and odors and absorb dissolved organic material, and chlorine dioxide was substituted for CI in the prechlorination step. When this system went on line, complaints ceased. At customer insistence, the water plant continued the activated carbon treatment year-round even when raw water quality improved. An unexpected benefit was the ability of the carbon columns to remove turbidity. Use of memores. An unexpected benefit was the ability of the carbon columns to remove turbidity. Use of chlorine dioxide was discontinued after the carbon system proved effective alone. (Cassar-FRC) W81-03941

VERSATILE COMPUTER CONTROLS ATLAN-TA WATER DISTRIBUTION, Atlanta City Bureau of Water, GA. T. E. Stallworth, Jr., T. M. Bavan, and J. C. New. Water and Wastes Engineering, Vol 17, No 5, p 16-19, May, 1980. 2 Fig.

Descriptors: \*Computers, \*Automatic control, \*Control systems, Remote control, Pumping, Water treatment, \*Water distribution, \*Atlanta, Georgia, Operation and maintenance, Management, Data processing, Data storage and retrieval, Montoring.

CASPER (Computer Analysis of System Pumpage and Energy Reduction) monitors the entire Atlan-ta, Georgia, water distribution system, stores inforta, Georgia, water distribution system, stores information, generates reports, alerts operators to alarm conditions, and controls remote stations. The system evolved from a simpler system, installed in 1975, which only monitored and averaged hourly distribution flow rate and pressures. It uses a DEC PDP-11/34 computer, a 16-bit minicomputer with a maximum of 124K words of main memory. Dual RL01 removable disc cartridges with a maximum of 2.6 million 16-bit words comprise the mass torage subsystem. A secondary storage subsystem. storage subsystem. A secondary storage subsystem is a RX02 dual floppy disc used for historical data. Operators communicate with CASPER through Operators commu three separate devices -- a cathode ray tube, a report writer which operates at 120 characters per second, and an event printer which operates at 30 characters per second. All programming is done in a top-down structured manner in high-level lan-guage to facilitate maintenance. A PDP-11/03 cen-tral telemetry unit communicates with microguage to lacintate maintenance. A PDF-17/03 cen-tral telemetry unit communicates with micro-processors at remote pumping stations. If the remote processors fail, control reverts to the central unit. Since the initial installation in July 1979, no down time for maintenance or failures in the software programming has been experienced. (Cassar-FRC)
W81-03942

ECONOMICALLY REMOVE TOXICS,

Houston Research, Inc., TX.

Notice of the state of the stat

Descriptors: \*Disinfection, \*Ozone, \*Ultraviolet radiation, Oxidation, Microorganisms, Organic matter, \*Wastewater treatment, Water treatment, Toxins, Chlorination, Costs, Bacteria, Comparative

A water disinfection process using both ozone and ultraviolet radiation (UV) was more effective in killing microorganisms than either ozone or UV alone. The ozone-UV reactor uses high shear field mixing to break up the gas bubbles and provide a high area of interface. In an experiment with secondary municipal effluent with initial plate count of 600,000 per ml, 95% kill was attained with UV and 10% of the ozone required when ozone is used alone. An ozone-UV run, using 1,000 per ml tap water spiked with secondary effluent, resulted in a

# Water Quality Control-Group 5G

99% kill in 15 sec and 99.8% in 30 sec. Total organic carbon removal was very rapid. Comparaorganic carbon removal was very rapid. Compara-tive treatment costs for a 100 mgd plant were (in cents per 1,000 gal):chlorine, 1.1; hypochlorite, 2.8; chlorine with declorination and post aeration, 1.9; ozone from air, 3.3; ozone from oxygen, 2.1; UV, 2.6; and ozone-UV, 2.1. Advantages of the ozone-UV process are speed, indifference to turbidity, cleanliness, no transportation of chemicals, and no chlorine residuals. (Cassar-FRC) W81-03948

# 5G. Water Quality Control

CURRENT ISSUES IN WATER POLLUTION CONTROL ADMINISTRATION IN JAPAN,

States/Japan
 Proceedings; Seventh United States/Japan
 Conference on Sewage Treatment Technology,
 May 19-21, 1980, Tokyo, Japan. Environmental
 Protection Agency Report EPA-600/9-80-047, December, 1980, p 37-55.
 Fig. 9 Tab.

Descriptors: \*Water quality control, \*Heavy metals, \*Eutrophication, \*Bays, \*Lakes, \*Reservoirs, Water pollution control, Oxygen demand, Legislation, Red tide, Phosphorus removal, Industrial wastewater, Domestic wastes, Nonpoint pollution sources, \*Japan.

An overall improvement in water quality has occurred in Japanese waters in recent years. Contaminants showing reductions include cadmium, cyanide, organic phosphorus, lead, chromium (VI), arsenic, mercury, and PCB's. BOD and COD levels have declined, but COD remains a problem in the 'enclosed' water areas of Tokyo Bay, Ise Bay and the Seto Inland Sea. COD loadings will be reduced according to a comprehensive pollutant reduction plan, which sets COD loads for each water body. Lakes and reservoirs are showing declines in water quality and a tendency to eutrophication. Lake Biwa is the largest lake in Japan, and has experienced red tides in recent years. In an and has experienced red tides in recent years. In an attempt to reduce phosphorus loading in the lake, phosphorus use has been reduced in industrial and phosphorus use has been reduced in industrial and domestic situations. This culminated in a law which bans the sale and use of phosphate-containing detergents and regulates the nitrogen and phosphorus levels in effluents from industrial plants and public sewage treatment facilities. Appropriate measures are to be taken to reduce nonpoint source pollution contributions to the content of the lake. (Brambley-SRC) W81-03611

ASSESSMENT OF LINER MATERIALS FOR

MUNICIPAL SOLID WASTE LANDFILLS, Matrecon, Inc., Oakland, CA. For primary bibliographic entry see Field 8G. W81-03637

FIELD VERIFICATION OF LINERS; ASSESS-MENT OF LONG-TERM EXPOSED LINER MATERIALS FROM MUNICIPAL SOLID WASTE LANDFILLS, EMCON Associates, San Jose, CA. For primary bibliographic entry see Field 8G. W81-03638

SUMMARY OF LANDFILL RESEARCH; BOONE COUNTY FIELD SITE, Regional Services Corp., Inc., Columbus, IN. R. J. Wigh, and D. R. Brunner. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: Al 2 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, Pennsylvania, Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 209-242. 25 Fig. 7 Tab, 8 Ref.

Descriptors: \*Landfills, \*Municipal wastes, \*Leachates, \*Leaching, Monitoring, Precipitation, Hydrologic budget, Climatic data, Pollutants, Chemical composition, Mass transfer, Prediction.

## Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

# Group 5G-Water Quality Control

Five municipal waste test cells were constructed at the Boone County Field Site, Kentucky, during 1971 and 1972, for the purposes of analyzing the amount and characteristics of leachate, and the amount and characteristics of leachate, and the composition of gases, and evaluating a clayey silt soil as an impervious liner for leachate control. Two cells were field-scale and three were small-scale for comparison purposes. All the cells were monitored until August 1980, when they were closed. Leachate collected from the larger field-scale cell was 27% of precipitation after 6.5 years. Water balance equations were reasonably accurate in predicting leachate quantity, if actual rather than average climatic data were used. Leachate concentration histories showed similar trends for all cells, with most parameter peaks occurring at field capacity. After 4-5 l/kg of refuse of leachate had been collected, contaminant concentrations field capacity. After 4-5 1/kg of refuse of leachate had been collected, contaminant concentrations were generally less than 10% of peak values. From 56-104g of COD, 11-13g of hardness, 1.2-1.5g of sulfate, 0.52-0.62g of Mg, 2.0-2.4g of chloride, and 1.9-3.6g of Fe per kilogram of dry refuse had been leached from the cells at the close of the study. Mass removal rate trends for all but Fe were tending to no further removal. A simple exponential examination provided an adequate description of tial equation provided an adequate description of the concentration histories of five of the six paramthe concentration insortes of the of the six parami-eters examined, and comparison of the calculated mass removals with the observed showed reason-able agreement. (Brambley-SRC) W81-03641

SECTION 404(B) TESTING, Army Engineer Div. North Atlantic, New York. For primary bibliographic entry see Field 5B. W81-03642

STATUS OF THE ENVIRONMENTAL AND WATER QUALITY OPERATIONAL STUDIES (EWQOS) PROGRAM,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. J. L. Mahloch.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 4. 7 p, 1 Tab.

Descriptors: \*Water quality, \*Environmental effects, \*Reservoir operation, \*Waterways, Research priorities, Planning, Baseline studies.

The Environmental and Water Quality Operational Studies (EWQOS) Program was initiated in FY 78 to engage in applied research on high priority environmental quality programs associated with Civil Works activities of the Army Corps of Engineers, and has been designed and conducted to be responsive to field office requirements including extensive technology transfer activities. Tangible benefits expected are reduced time and resource requirements to solve environmental quality probrequirements to solve environmental quality prob-lems plus documentation of environmental benefits accrued by technology developed under EWQOS. Information is provided on the status and accom-plishments of each project under the program. During the first two years, a majority of the effort accounted with the recovery here benedited to associated with the program has been directed at literature reviews, planning and initial efforts associated with long-term field studies, and preliminary or background laboratory studies to establish the direction of technology development and demon-stration for the remainder of the program. Major projects include: predictive techniques for deter-mining environmental effects; reservoir operation and management techniques; engineering tech-niques for meeting reservoir water quality objec-tives; environmental assessment techniques for project planning and operational requirements; environmental impacts of waterway activities; water-way project design and operation for meeting environmental objectives; and long-term comprehensive field studies. (Moore-SRC) W81-03643

PROTOTYPE STUDY: OXYGEN INJECTION

SYSTEM,
Army Engineer District, Savannah, GA.
R. C. Miller, and J. W. Gallagher.
In: Proceedings of a Seminar on Water Quality
Evaluation, 22-24 January, 1980, Tampa, Florida.

Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 7. 7 p, 7 Ref.

Descriptors: \*Dissolved oxygen, \*Hypolimnion, \*Reservoir releases, \*Oxygenation, Water quality, Thermal stratification, Reservoir operation, \*Sa-

The lakes of multipurpose hydroelectric projects on the Savannah River, like most deepwater bodies, undergo stratification. In all of these projects the turbine intakes are located far below the obodies, undergo stratification. In all of these projects the turbine intakes are located far below the surface in the hypolimnion, so that during the summer the waters released have progressively reduced oxygen levels. In order to meet state water quality standards in releases from Clark Hill Dam, 7,500 tons of oxygen would have to be supplied seasonally to maintain a dissolved oxygen level of 6 ppm. Field tests were conducted at Clark Hill Lake using an oxygen injection system. Continuous oxygen injection through porous diffusers into the lake at a point several days travel time upstream of the dam is considered the most feasible alternative. Oxygen loading rates of 250 and 500 pounds per sq ft were found to be optimal. A linear configuation of diffusers is effective in decreasing excessive pumping of oxygenated water. The most effective plume deflector was a 1 inch diameter PVC pipe grid with 1/2 inch clear spacing. (Moore-SRC) W81-03646

LOST CREEK LAKE TURBIDITY STUDY EVALUATION,

EVALUATION, Army Engineer District, Portland, OR. R. A. Cassidy. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 10. 4 p, 1 Ref.

Descriptors: \*Selective withdrawal, \*Reservoir operation, \*Turbidity, \*Reservoir releases, Water pollution, Storm runoff, Water quality, Sediment load, \*Lost Creek Lake, Oregon.

Lost Creek Lake is a Portland District impound-Lost Creek Lake is a Fortiand District impoundment located in the southern part of Oregon on the Rogue River. Lost Creek is the first project in the district with multilevel withdrawal capability. Water can be withdrawn from 5 levels within the impoundment. Water quality studies have been ongoing through the pre-impoundment closure and post-impoundment periods, at the reservoir. The post-impoundment periods, at the reservoir. The most significant stream turbidity measured in the upper Rogue River since the completion of Lost Creek Lake occurred during the first year of closure, when two storms occurred during the winter. Both storms produced inflow turbidity levels of approximately 60 Jackson Turbidity Units (JTU). During the eight months previous to the first storm, the turbidity level in the reservoir was generally less than 2 JTU. Following the first storm, the low level withdrawal capability was not used. The turbidity stratification near the dam used. The turbidity stratification near the dam ranged from less than 5 JTU near the surface to 60 JTU at the reservoir bottom. Following the second storm, the low level withdrawal outlet was used, reducing turbidity stratification at the reservoir bottom to between 10 and 20 JTU. It took approximately one month to reduce the turbidity level to less than 5 JTU throughout most of the water column. These preliminary results indicate that multilevel withdrawal at dams can make great (Moore-SRC)
W81-03649

SYNOPSIS OF WES EWQOS INVESTIGA-TIONS TO IMPROVE WATER QUALITY BY GAS TRANSFER TECHNIQUES BOTH IN THE RESERVOIR AND IN THE RELEASE, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. D. R. Smith.

D. R. Smith. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 23. 15 p, 2 Fig.

Descriptors: \*Dissolved oxygen, \*Hypolimnion, \*Reservoirs, \*Water quality, \*Oxygenation, Reser-

voir releases, Thermal stratification, Destratifica-tion, Nitrogen, Outlets, Hydraulic structures, Hy-draulic modeling, Model studies, Supersaturation.

During late spring and summer, density stratifica-tion may result in the reduction or depletion of dissolved oxygen in the hypolimnion, leading to anaerobic conditions. This not only results in poor water quality in the lower region of the reservoir; it also impacts downstream water quality if hypo-limnetic releases are required for flood control or to meet cold water temperature objectives. Several techniques to enhance the water quality by gas transfer techniques both in the reservoir and in the downstream release are being investigated, includ-ing oxygenation and pneumatic destratification. As demonstrated at Clark Hill, efficient oxygen injec-tion schemes can be used to increase the dissolved oxygen in the hypolimnion without significantly disturbing stratification. Field results indicate that line injection systems are more effective than recline injection systems are more effective than rectangular arrays of rack mounted diffusers. Pneumatic destratification can also be used to increase matic destratification can also be used to increase the DO in the reservoir; however, some degree of nitrogen supersaturation with respect to the surface is likely to occur. It may necessitate the use of outlet works which degas the release. In some cases, pneumatic destratification will not be a viable alternative as a result of the inherent increase in water temperature. The released water quality can be improved by employing hydraulic structures which aerate the flow and increase the DO without significantly increasing the dissolved nitrogen concentrations. Techniques have been developed to assist in designing environmentally effective hydraulic structures. The approach utilizes a coupling of hydraulic modeling, flow visualization and radioactive tracer techniques to determine the relative effectiveness of various outlet work the relative effectiveness of various outlet work designs and/or structural modifications. Implementation through various site specific model studies will result in more cost effective designs and should prevent ineffective structural modifications. (Moore-SRC) W81-03658

CORROSION INHIBITION, Petrolite Corp., St. Louis, MO. (Assignee). For primary bibliographic entry see Field 5F.

FILTER, Universal Water Systems, Inc., Chicago, IL. (As-For primary bibliographic entry see Field 5F. W81-03668 signee).

OIL-WATER SEPARATION FILTERS, Somar Mfg., Co., Ltd., Tokyo (Japan). (Assignee). Y. Goto, Y. Daigo, and M. Hitotsuyanagi. U.S. Patent No 4,212,733, 6 p. 5 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 1005, July 15, 1980.

Descriptors: \*Patents, \*Water pollution treatment, \*Oil pollution. \*Filtration, Industrial wastes, Separation techniques, Water purification, Water quality control, Filters, Emulsified oils, Ballast water.

One object of this invention is to provide a filter which permits continuous, efficient and simple sep-aration and removal of oils from great quantities of water containing oils, thereby providing clear water having an extremely low oil content. A filter is provided for separating oils from water compris-ing a first filter layer of a porous material produced from a sinterable polyethylene powder, or a mix-ture of such a polyethylene powder and a powder of a heat-resistant organic or inorganic material, which is bonded to a second filter layer comprising a fibrous layer. (Sinha-OEIS) W81-03672

DEVICE FOR COLLECTING MATERIALS AS FOR EXAMPLE OIL FLOATING ON A WATER

FUR EXAMPLE OUR TABLE SURFACE, K. H. Nyfeldt, and K. T. Y. Bernhardsson. U.S. Patent No 4,211,659, 10 p, 10 Fig, 4 Ref, Official Gazette of the United States Patent Office, Vol 996, No 2, p 624-625, July 8, 1980.

# Techniques Of Planning-Group 6A

Descriptors: \*Patents, \*Oil pollution, \*Oil spills, Water quality control, Skimming, Equipment, Floating, Oil recovery, \*Water pollution control,

An apparatus is described for collecting materials, such as oil floating on water, wherein the materials are funnelled into a collecting device by floating walls towed through the water. The collecting device is a succession of hose-shaped sections detachable interconnected to each other so that the trailing end section may be pursed sealed and detached when a sufficient amount of the collected material is received. (Sinha-OEIS)

PROCESS FOR CLARIFYING WATER, For primary bibliographic entry see Field 5F. W81-03704

COST-EFFECTIVE WATER QUALITY PLAN-NING FOR URBAN AREAS, CH2M/Hil, Inc., Reston, VA. F. W. Ellis, and R. L. Wycoff. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 246-258, February, 1981. 11 Fig, 7

Descriptors: \*Water quality control, \*Cost analysis, \*Urban watersheds, Planning, Water quality standards, Water quality management, Model studies, Urban planning, Water pollution prevention, Simulation analysis, Economic aspects, Stormoverflow sewers

A two phase plan for water quality control was formulated which determines the most cost-effective combination of pollution control alternatives tive combination of pollution control alternatives needed to attain a given water quality standard. The first phase integrates the essential features of an urban area and its receiving waters into a simple, continuous hydrologic/water quality simulation model to clarify the relationships of the cost of test-leading and test-lea ation model to callify the relationships of the cost of total pollution abatement optimum control technologies and the receiving waters. These associations offer a framework for the re-evaluation of water quality goals. Water quality standards may be examined relative to actual costs. When necessary, receiving water criteria can be modified, and a cost-effective pollution abatement project may be developed. The second phase analysis has as its goal the description of optimal control alternatives.
These choices may include such parameters as preliminary design, total costs, and response of receiving water quality to the plan. (Geiger-FRC) W81-03759

POLLUTION POTENTIAL AND CORN YIELDS FROM SELECTED RATES AND TIMING OF LIQUID MANURE APPLICA-TIONS.

Department of Agriculture, Ottawa (Ontario). Engineering and Statistical Research Inst. For primary bibliographic entry see Field 5B. W81-03766

KEPONE REMOVAL FROM AQUEOUS SOLU-TION BY IMMOBILIZED ALGAE, West Virginia Univ., Morgantown. Dept. of Mi-

crobiology.

R. S. Pore, and W. G. Sorenson.

Journal of Environmental Science and Health, Vol
A16, No 1, p 51-63, 1981. 1 Tab, 13 Ref.

Descriptors: \*Bioaccumulation, \*Algae, \*Chlordecone, Water quality control, Aflatoxins, Model studies, Activated charcoal, Adsorbents, Resins, Water pollution control, Pesticides, Halogenated pesticides, Chlorinated hydrocarbons, Separation techniques, \*Kepone removal.

The bioaccumulation of Kepone (chlordecone) by an immobilized form of the achlorophyllous algae, Prototheca zopfii, was studied in a model laboratory system using a bioaccumulation column. An aqueous solution containing 1 ppm Kepone was passed through a fixed bed column containing the immobilized alga in agar beads. Kepone was removed from the solution with about equal efficien-

cy by immobilized activated charcoal and the immobilized algae. The hydrophobic XAD-2 resin adsorbent was less efficient than these in removing the pesticide from solution. The removal of Kepone could not be attributed to hydrophobic apartitioning, as the hydrophobic aflatoxin G1 was not bioaccumulation occurred in living than in formatin-killed algal cells. No biodegradation of Kepone or aflatoxin G1 by P. zopfii was observed. (Geiger-FRC) W81-03833

ECOLOGICAL PERSPECTIVE ON WATER QUALITY GOALS,

Illinois Univ. at Urbana-Champaign. Dept. of

Leongy, J. R. Karr, and D. R. Dudley. Environmental Management, Vol 5, No 1, p 55-68, January, 1981. 6 Fig. 4 Tab, 35 Ref.

Descriptors: \*Water quality control, \*Clean Water Act, Reviews, Streams, Black Creek Project, Water resources development, Ecology, Water pollution sources, Case studies, Indiana, Aquatic life, Aquatic habitat, Agricultural watersheds, Nonexistral bulstics executions. Nonpoint pollution sources

The objectives and goals of the Clean Water Act and the ability of current programs to meet those objectives are reviewed. Nonpoint pollution abatement programs in the United States are reviewed, and experiences are cited regarding an ongoing study, the Black Creek Project in Allen County, Indiana. Biological integrity is discussed and the fundamentals of stream biology considered to emphasize the need for a holistic approach to water resource management. Traditional soil and water conservation management and an innovative approach designed to restore biological integrity are explored. Several key problems are addressed as they occur in agricultural watersheds: allocthon-The objectives and goals of the Clean Water Act explored. Several key problems are addressed as they occur in agricultural watersheds: allocthon-ous organic matter inputs, nutrient availability, sunlight availability, temperature and dissolved oxygen imbalance, stream habitat characteristics, seasonal low flows, and changes in insect and fish communities. (Baker-FRC) W81-03835

INCREASE IN STREAM PH AFTER A FOREST DRAINAGE,

Uppsala Univ. (Sweden). Inst. of Limnology. L. Ramberg. Ambio, Vol 10, No 1, p 34-35, 1981. 2 Fig, 13 Ref.

Descriptors: \*Hydrogen ion concentration, \*Acidic water, \*Forest watersheds, Drainage ditches, \*Drainage effects, Alkalinity, Lime, Streams, Kloten, \*Sweden, Watersheds, Surface waters, Peat, Water pollution control, Groundwater, Conveyance systems, Water conveyance, Open channels, Channels, Water pollution sources, Open channels, Channels, Water pollution sources, Organic soils.

Drainage ditches mechanically dug in peaty topsoil in a clear cut forest near Kloten, Sweden, caused groundwater to increase in pH (from 4.9 to 5.8) and remain less acid for 2 years. Alkalinity increased from 0 to a mean value of 110 microequivalents per liter. Water entering the soil upland percolates through the peat, becoming acidified as it flows toward the stream. Drainage ditches permitted groundwater to reach the stream more permitted groundwater to the permitted groundwater to the stream more permitted groundwater to the permitted groundwater to the stream more permitted groundwater to the permitted mitted groundwater to reach the stream more rapidly, thus retaining more alkalinity. (Cassar-FRC) W81-03845

INTERNATIONAL TRENDS IN WATER MAN-

For primary bibliographic entry see Field 6E. W81-03880

SALT RELEASE AND MOVEMENT IN PROCESSED OIL SHALE,

Wyoming State Dept. of Environmental Quality, Cheyenne. Land Quality Div. For primary bibliographic entry see Field 5B.

WOOD STAVE TANKS ARE MEMBRANE LINED FOR CHEMICAL STORAGE AT LORNE PARK WATER PURIFICATION PLANT.

Water and Pollution Control, Vol 119, No 1, p 15, January, 1981.

Descriptors: \*Linings, Hydraulic engineering, Structural engineering, Materials engineering, Plastics, Polymers, Storage tanks, \*Water pollution

The Lorne Park Water Purification Plant of Mississauga, Ontario, is using wood stave tanks with polyvinyl chloride (PVC) liners for storing chemicals. Four tanks approximately 14 ft by 14 ft with a capacity of 12,000 gallons are used for storing alum and sodium hypochlorite. A 10 ft by 12 ft, 5,200 gallon capacity tank is used for hydrofluosilicic acid storage. PVC liners offer good tensile, elongation, and tearing strengths, and are resistant to many chemicals and extremes of temperature. Wood tanks are easy to install and provide natural many chemicals and extremes of temperature. Wood tanks are easy to install and provide natural insulation for energy efficiency. Electric strip heating may be employed when necessary, and wood stave tanks with PVC liners can be constructed in stave tanks with PVC lines can be constructed in many versatile shapes. The PVC lined wood stave tanks are also highly resistant to acid attack, making them attractive choices for hostile elements and environments. (Geiger-FRC) W81-03901

BACTERIAL BED CONSUMES PHENOL For primary bibliographic entry see Field 5E. W81-03905

# 6. WATER RESOURCES **PLANNING**

# 6A. Techniques Of Planning

ON RESERVOIR RELIABILITY. Natal Univ., Durban (South Africa). Dept. of Civil Engineering.

For primary bibliographic entry see Field 2H.

AQUIFER RESPONSE TO FORECASTING INPUTS.

Birmingham Univ. (England) Dept. of Civil Engi-

K. R. Rushton, and L. M. Tomlinson. Journal of Hydrology, Vol 48, No 1/2, p 167-183, August, 1980. 7 Fig. 3 Tab, 10 Ref.

Descriptors: \*Aquifers, \*Forecasting, \*Mathematical models, Groundwater, Time series analysis, Precipitation, Evaporation, Recharge, Groundwater recharge, Limestone, Confined aquifers, Seasonal variation, Groundwater movement, Storage capacity, Soil moisture deficiency, Southern Lincolnshire, Limestone aquifer, Great Britain.

colnshire, Limestone aquifer, Great Britain.

Recharge is calculated from forecasted precipitation and evaporation and used as an input for a mathematical model of the Southern Lincolnshire Limestone aquifer. Three methods of forecasting were selected, an overall average, a monthly average, and a value dependent on certain earlier months. The suitability of the estimates of recharge based on these forecasts is examined and they are included in the model, which steps forward one, two, or three months. The outputs of the model resultant groundwater heads - are compared with those given by historic data for the years between 1962 and 1977. Forecasts based on overall averages had the best fit. Even with this model some predicted values were significantly different from historic values. It was found that forecasts were poorest when unusual recharge events occurred. Because only three months of record were extrapolated from the historic pattern, errors were generally moderate. The forecasting methods presented have application in decisions about permissible abstractions from the aquifer. (Titus-FRC) W81-03714

#### Field 6-WATER RESOURCES PLANNING

# Group 6A-Techniques Of Planning

LOS ANGELES UTILITY'S MANAGEMENT TAKES TIME AND SAVES MONEY,

Water/Engineering and Management, Vol 128, No 3, p 24, 90, March, 1981.

Descriptors: Personnel management, \*Management planning, \*Cost analysis, \*Water management, Performance evaluation, Water treatment facilities, Utilities, Needs assessment, Efficiency evaluation, \*Los Angeles, California.

The water utility management for the city of Los Angeles, California, initiated a needs assessment program to identify personnel needs and to improve the deployment of crews and the efficiency of their efforts. The Water Operating Division District Operations Section initiated information-District Operations Section initiated information-gathering procedures to identify the amount and kinds of work involved in a project's subroutines. These procedures consisted of time-measurement approaches using broader task concepts than are normally used in such studies. Considerable preplanning time by management contributed significantly to the success of the program. A five-step procedure was developed to encourage the participation of affected personnel in the time-management program and to minimize resistance to change. Another factor which has contributed to the program's success was the decision to utilize supervisory personnel as members of the data gathsupervisory personnel as members of the data gathering study groups and to avoid the use of consultant teams. The benefits of the program have been quite rapid, with some changes and savings effected within two months. (Carroll-FRC)

TRENDS--IN MANAGEMENT,

G. E. Symons. Water/Engineering and Management, Vol 128, No 2, p 14, 64, February, 1981.

Descriptors: \*Management planning, \*Wastewater management, \*Water management, Economic as-pects, Political aspects, Utilities, Environmental policy, Wastewater treatment.

A variety of recent events may or may not signal trends for the future with respect to the manage-ment of water and wastewater utilities. Professionment of water and wastewater utilities. Profession-al societies have opposed proposed amendments to drinking water standards legislation. Fred Griffiths of the Fairfax County Water Authority in Virginia has proposed a system of establishing water utility rates to meet increasing demands which would require new metered customers to pay a higher rate than existing users and to pay a one-time, per-unit connection charge. The Environmental Pro-tection Agency (EPA) has relaxed its wastewater treatment requirements for the Hopewell, Virginia, wastewater treatment plant. The cost of constructing wastewater treatment facilities was not increasing as rapidly in February, 1981, as it was one year earlier. Managers of water utilities in New Engearlier. Managers of water utilities in New England have reported that they spend 25% of their time on financial matters; 27% on scheduling, coordinating, and supervising; 21% on public relations; 19% on personnel matters; and 7% on capital planning. The Water Pollution Control Federation has called for repeal of the Industrial Cost Recovery provision of the Clean Water Act. Associated Builders and Contractors is lobbying for amendment of federal law to permit government contractors to work four 10-hour days per week. The future of the Clean Water Act is uncertain at The future of the Clean Water Act is uncertain at The future of the Clean Water Act is uncertain at this time. The 1980 elections resulted in the approval by voters of the expenditure of \$840 million for water and wastewater facilities around the country. Changes can be expected in the policies of the EPA with respect to management of hazardous wastes, pollution, funding of wastewater facilities, and water supplies, but what these changes will involve is not yet certain. (Carroll-FRC)

INCREASING EMPLOYEE SECURITY AND PRODUCTIVITY WITH COMPUTERS, Denver Water Dept., CO.

W. H. Miller.

Journal of the American Water Works Associ-ation, Vol 73, No 3, p 136-139, March, 1981.

Descriptors: \*Digital computers, \*Education, \*Employee relations, Economic aspects, Personnel management, Data processing.

Education and training programs can help employ-ees understand electronic data processing. A com-puter can provide an employee with information that can add to his sense of security with a compa-ny, help him understand the financial situation, and provide incentive for improving job performance. A computer helps provide employee performance reports which give supervisors a tool for meeting with employees and reviewing their progress. This indicates management's interest in the general wel-fare of employees. Also, the computer provides a check stub which indicates amounts of taxes with-eld, cumulative days of sick and vacation time. check stub which indicates amounts of taxes with-eld, cumulative days of sick and vacation time available, deductions for credit unions, gross pay, net pay etc. Employees should realize that ma-chines do not necessarily replace people. Machines may perform clerical tasks and provide jobs for a higher level employee. New roles can usually be found for replaced employees within a large orga-nization. Proper training of employees can con-vince them that the computer is a tool, not a threat. (Small-FRC) W81-03816

MANCHESTER, CONNECTICUT'S INFORMA-TION COLLECTION AND MANAGEMENT SYSTEM FOR WASTEWATER TREATMENT, Metcalf and Eddy, Inc., Boston, MA. D. Vander Schaaf.

Water/Engineering and Management, Vol 128, No 3, p 72, March, 1981.

Descriptors: \*Data acquisition, \*Management information systems, \*Wastewater facilities, Information systems, \*Wastewater treatment, Information retrieval, Management planning, Manchester, Con-

Design efforts for the upgrading and expansion of the Manchester, Connecticut Wastewater Treat-ment Facilities call for the inclusion of a digitally based data logging system. The basic components of the data logging system are conventional proc-ses instrumentation; conventional instrumentation panels for local display and control process variables; multiplexers to code and transmit the infor-mation from the local instrumentation to the data logging system; a data logging, storage, and proc-essing unit; and data input and output devices. Keyboards can be used to manually input such data as laboratory analysis results. The use of this system will allow for collection, management, and reduction of considerably more data than would be possible with a manual system and will provide better automated plant records, a greater information base for operational decision-making, and a reduction in the time required to produce plant reports. (Carroll-FRC) W81-03890

COOPERATION FORMS FOUNDATION FOR WWTP GROWTH,

Killam (Elson T.) Associates, Inc., Millburn, NJ. For primary bibliographic entry see Field 5D. W81-03936

# 6B. Evaluation Process

AN ASSESSMENT OF WATER USE AND POLICIES IN NORTHERN COLORADO CITIES, Colorado Water Resources Research Inst., Fort Collins.

K. N. DiNatale.

A. N. DINataie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215915, Price codes: Al 1 in paper copy, AO1 in microfiche. Technical Report No 28, March, 1981. 229 p. 16 Fig. 36 Tab, 96 Ref. OWRT-A-042-COLO(2), 14-34-0001-9006 & 0106.

Descriptors: Municipal water conservation, \*Municipal water use, \*Water metering, Water use, \*Municipal water, Water supply, Water rates, Pricing, Surveys, Water rights, \*Colorado, Front range

Municipal water management policies and water use patterns were examined in 25 northern Colorause patterns were examined in 25 northern Colora-do Front Range communities. Towns were classi-fied on the basis of population; extent of metering, if any; and source of water supply, groundwater or surface water. Water use patterns were analyzed for a four-year period, 1975 to 1978. The effects of metering, water use restrictions and the 1976-1977 metering, water use restrictions and the 1976-1977 drought period on municipal water use were also determined. Metering of all residential customers was found to be the practice in 11 of the 25 communities. Per capita water use was lower in the metered towns than in the unmetered towns, but the actual per capita use varied greatly among the individual towns. Metering was particularly effective in reducing per capita outdoor water use. Lawn watering restrictions were widely practiced in the unmetered towns and judged to be generally less effective than metering without restrictions in reducing average and peak outdoor water use. Interviews were conducted with town water managers regarding municipal water management poliagers regarding municipal water management poli-cies. Water rates, pricing policies, revenues from water sales and tap-on fees varied greatly in both the metered and unmetered towns. The majority of the metered and unmetered towns. The majority of the towns required water rights contributions from new developments. Exclusive of these water rights donation requirements, planning for future raw water supply needs and estimates of the depend-able yield of water rights owned were judged to be inadequate in many towns. The possible benefits and costs of increased efficiency of water use on municipal return flows and water rights were de-termined and evaluated. termined and evaluated. W81-03603

PUBLIC EVALUATION OF WASTEWATER

PUBLIC EVALUATION OF WASTEWATER REUSE OPTIONS, California Univ., Berkeley. Dept. of Social and Administrative Health Services. For primary bibliographic entry see Field 3C. W81-03726

COST-EFFECTIVE WATER QUALITY PLAN-NING FOR URBAN AREAS, CH2M/Hill, Inc., Reston, VA. For primary bibliographic entry see Field 5G.

A PREDICTIVE MODEL OF WATER STRESS IN CORN AND SOYBEANS, Washington State Univ., Pullman. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2I. W81-03761

COMMUNITY PARTICIPATION IN THE RURAL WELL CONSTRUCTION PROGRAMME OF GUINEA-BISSAU, J. D. van der Ploeg, and C. A. van Wijk-Sijbesma. Aqua, No 9/10, p 21-23, 1980. 2 Tab, 7 Ref.

Descriptors: \*Wells, \*Construction, \*Community development, Guinea-Bissau, Well construction, Water resources development, Resources development, Regional development, Water supply development, Water supply, Water management, Resources management, Rural areas.

The water program in Buba Tombali, Guinea-Bissau, is described as one in which successful intergration of a community participation compo-nent has been incorporated into a rural drinking water supply program. The community members participate at all levels of the water supply system. Individuals drawn from the areas they serve guide the process. An evaluation of the program at the village level is offered, along with recommenda-tions for further study and expansion of the ideas into other areas. (Baker-FRC)

# 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

INDUSTRIAL WASTEWATER REUSE: COST ANALYSIS AND PRICING STRATEGIES,

# Water Demand—Group 6D

Montgomery (James M.), Pasadena, CA. For primary bibliographic entry see Field 3C. W81-03601

INDUSTRIAL WASTEWATER REUSE: COST ANALYSIS AND PRICING STRATEGIES: AP-PENDICES,

Montgomery (James M.), Pasadena, CA. For primary bibliographic entry see Field 3C. W81-03602

AN ASSESSMENT OF WATER USE AND POLICIES IN NORTHERN COLORADO CITIES, Colorado Water Resources Research Inst., Fort Collins.
For primary bibliographic entry see Field 6B. W81-03603

MANAGING ENERGY AT WATER-POLLU-TION-CONTROL FACILITIES, Metcalf and Eddy, Inc., Boston, MA. For primary bibliographic entry see Field 5D. W81-03775

ON THE MARGINAL COST OF WATER SUPPLY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
For primary bibliographic entry see Field 5F.
W81-03793

INVESTMENTS IN WATER SUPPLY AND SANITATION, World Health Organization, Geneva (Switzerland). E. Becher.

Aqua, No 9/10, p 208-216, 1980. 3 Tab.

Descriptors: \*Economic aspects, \*Water supply, \*Sanitation, Financing, Financial feasibility, Costs, Cost analysis.

Financial decisions that must be made in dealing with problems of water supply and sanitation are discussed. Assuming normal average performance is met, the single most important factor in determining the level and composition of running costs is investment costs. A multinational analysis was undertaken by the WHO/World Bank Cooperative program in 1977-1979. The program was in preparation for the International Drinking Water Supply and Sanitation Decade of 1981-1990. The extent of the investment problem faced by the Decade in terms of unmet needs is described. Additionally, a country classification system is presented which facilitates the task of investment policies planning at various levels both nationally and internationally. The pattern of investment costs that results from the examination of national data and project information is also described. Conclusions are of-fered concerning the conformity of present water supply and sanitation programs with respect to prevailing economic and social policies of various countries. (Baker-FRC)

# 6D. Water Demand

PRACTICAL APPLICATIONS FOR REUSE OF WASTEWATER,

WASTEWATER, Japan Sewage Works Agency, Tokyo. For primary bibliographic entry see Field 3C. W81-03618

VENTURA COUNTY WATER MANAGEMENT PROJECT CALIFORNIA; CONCLUDING REPORT ON THE INVESTIGATION OF THE FEASIBILITY OF WATER SUPPLY DEVELOPMENT.

Water and Power Resources Service, Mid-Pacific Region, Sacramento, California, January, 1981. 200 p, 13 Fig, 21 Tab, 1 Append.

Descriptors: \*Water resources development, \*Wastewater renovation, \*Groundwater recharge,

\*Water demand, \*Feasibility studies, Groundwater mining, Alternative planning, Water requirements, Secondary wastewater treatment, Streamflow, Flow augmentation, Saline water intrusion, Wetlands, Recreation, Fisheries, \*Ventura County, California.

The feasibility investigation of the Ventura County Water Management Project was initiated in 1973 to formulate plans for meeting countywide water needs, with heavy reliance on reclaiming municipal waste water. The planning area is an agricultural greenbelt located in the alluvial valleys and coastal plain, with both rural and urban development. By the year 2000 the population is expected to increase to 800,000, and water requirements to almost 365,000 acre-feet annually, requiring the development of an additional 50,000 acre-feet of water. The groundwater supply is presently being overdrafted by about 60,000 acre-feet a year. A supply of municipal wastewater with secondary treatment could be put to such uses as streamflow augmentation, greenbelt irrigation, agricultural use, and improvement of groundwater quality by reducing total dissolved solids content and by preventing seawater intrusion. Additional water supplies could also be used to enhance recreation and fisheries. Three water supply development plans were developed, a national economic development plans, an environmental quality plan, and a combination plan. The combined plan was selected as being the best overall plan. By the year 2000, about 7,400 acre-feet of the project water supply would be used for groundwater recharge and 76,400 acre-feet of rigation of 38,200 acres. The plan would develop 535 acres of wetland area, and 2,370 acres of recreation area. Because of the lack of local support for the Federal authorization and construction of the water management project as planned, the feasibility investigation is being terminated. (Moore-SRC)

SOLANO COUNTY WATER PROJECT - CALI-FORNIA; CONCLUDING REPORT ON THE FEASIBILITY INVESTIGATION OF AGRICUL-TURAL, MUNICIPAL, AND INDUSTRIAL WATER REQUIREMENTS OF SOLANO COUNTY.

Water and Power Resources Services, Mid-Pacific Region, October, 1980. 127 p, 13 Fig, 19 Tab.

Descriptors: \*Water resources development, \*Water requirements, \*Planning, \*Population dynamics, Alternative planning, Conjunctive use, Water reuse, Land use, Industrial water, Agriculture, \*Solano County, California.

Solano County is located in northern California. Its 583,000 acres of land and water encompass parts of the Coast Ranges and the alluvial flood plains of the Sacramento River Valley. Alternative solutions, including provision of supplemental water, to meet several water-related needs which now exist or could exist within the county were evaluated. Water requirements were determined from updated land use, population forceasts, and industrial projections. The overall plan was designed to satisfy the requirements for supplemental water and facilities through the year 2020. Solano County has been experiencing a rapid rate of growth over the last decade. Under the alternative futures method of planning, the 1975 population 187,700 can be expected to increase either by 207,000 or 397,000. Supplemental water supply alternatives include: redetermination of the Solano Project yield in light of operating experience and changing requirements, criteria and general planning for the West Sacramento Canal Unit, timing and design capacity of the California North Bay Aquaduct, water supply facilities proposed in the Montezuma Hill appraisal study, waste-water reuse opportunities, and conjunctive use of ground and surface water. Water requirements for the county, excluding Suisun Marsh, can be met by existing water supplies, local development and State contract facilities through the year 2000. (Moore-SRC) W81-03666

ARE WE REALLY RUNNING OUT OF WATER, CH2M/Hill, Denver, CO.

Water/Engineering and Management, Vol 128, No 3, p 26, March, 1981.

Descriptors: \*Water management, \*Water resources development, \*Water quality, Resources management, Water supply development, Water pollution control, Water reuse, Water conservation, Public policy.

A variety of current water resource management concerns have direct implications for the future adequacy of the nation's water supply. If efforts to develop new water resource management skills and new technology to solve such concerns as energy development, agricultural demands, population shifts, and contamination of groundwater continue, future water supplies can be expected to be adequate to meet the needs. However, if water management style and technology is unable to adapt, and if the regulatory approach remains unchanged, shortages may be expected in the future. Sound common-sense water quality regulations are needed to protect both surface water and groundwater supplies. Water quality regulations should relate to the capacity and ability of the river system involved to assimilate wastes. State laws must be updated. Federal control may be necessary to balance the needs of states sharing common groundwater aquifers. Water conservation, including the development of storage reservoirs, should be practiced by all municipal, industrial, and agricultural users. Water reuse will be increasingly used as a management option in water-short areas. Water resource management should develop and make use of the skill of public participation as an alternative to lengthy litigation. (Carroll-FRC) W81-03792

IN SEARCH OF A WATER REVOLUTION: QUESTIONS FOR CANAL IRRIGATION MANAGEMENT IN THE 1980'S,

R. Chambers. Water Supply and Management, Vol 5, No 1, p 5-18, 1981. 45 Ref.

Descriptors: \*Irrigation canals, \*Water management, Water resources development, Water use, Water supply development, Irrigation, Land use, Planning, Water distribution, Water conveyance, Water shortage, \*Asia.

This paper discusses the main system operation of large and medium sized canal irrigation presently coccurring in South and Southeast Asia. In developing any irrigation system certain key factors must be considered, among which are: productivity, the ratio of production or of some measure of economic value of production to the resource used; equity, as it refers to a fairer distribution of resources and livelihoods; stability, referring to the capacity for long-term sustained irrigation without environmental depletion, deterioration or loss of productivity; and utility to irrigators, concerning quantity, and utility to irrigators, concerning quantity, and utility to irrigators, concerning quantity, endergone of the promote before a project is undertaken include geographical accessibility, prominent project bias, design and construction bias, quantification, and diplomatic considerations. One large factor which must be studied more effectively than has been done in the past deals with the behavior, motivation and management skills of those who will be directly involved in the management and distribution of the water. The questions of who will gain and who will lose from any proposed redistribution of water must be addressed in any planning meeting where water control is a topic. (Baker-FRC)

CARIBBEAN BASIN WATER MANAGEMENT PROJECT.

PROJECI.

Food and Agriculture Organization of the United Nations, Bridgetown (Barbados). Caribbean Basin Water Management Project.

Aqua, No 97(10, p 16-17, 1980.

Descriptors: \*Caribbean, \*Water management, Resources management, Training, Planning, Management planning, Communication, \*International agreements, International commissions, Organizations.

#### Group 6D-Water Demand

Resolutions and recommendations evolving from the UN Water Conference held at Mar del Plata, Argentina in March 1977 are reviewed. These recommendations are concerned with the Caribbean Basin water management project, and call for edu-cation and training for all levels of personnel dealing with water resources development, collaboration with government regarding manpower surveys, the establishment of national training programs, the publication of technical manuals and other guidance materials, encouraging operational managers and supervisors to take active roles in water management, and cooperation among developing countries. Various benefits derived from these recommendations since the conference have included the acceptance of training responsibilities by supervisors, the implementation of well con-ducted training programs, and evidence of better job performance. A clearer defining of job respon-sibilities has taken place, a positive change in the attitude of supervisors toward subordinates has arisen, and more communication is noted among utility staff. W81-03920

# WELL SOLVES WATER SHORTAGE, PRE-SERVES SCENIC RIVER.

Hammond, Collier and Wade-Livingstone Associates, Inc., Seattle, WA. For primary bibliographic entry see Field 8A. W81-03933

#### 6E. Water Law and Institutions

MUNICIPAL TREATMENT REQUIREMENTS AND PRACTICES TO MAINTAIN WATER QUALITY IN THE TAMPA AND ESCAMBIA BAY AREAS.

Florida State Dept. of Environmental Regulation, Tallahassee. Div. of Environmental Programs. For primary bibliographic entry see Field 5D. W81-03619

# IMPROVED OPERATION AND MAINTE-NANCE OPPORTUNITIES AT MUNICIPAL TREATMENT FACILITIES.

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div. For primary bibliographic entry see Field 5D. W81-03625

#### WATER USE CONFLICT NEAR MADISON. NERRASKA.

Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.

M. Ginsberg.

Water Resources Bulletin, Vol 17, No 1, p 133-137, February, 1981. 8 Fig.

Descriptors: \*Water rights, \*Irrigation wells, \*Drawdown, Water wells, Judicial decisions, Domestic water, Head loss, Madison, \*Nebraska, Wells, Groundwater movement, Legislation, Legal aspects, Aquifers, Geohydrology.

The rapid increase in the number of irrigation wells in Nebraska has caused many water use conflicts. One case involved installation of an irrigation well in the spring of 1976 near Madison. After only 9.5 hours pumping, four nearby domes-tic wells had considerable head loss. Domestic use is given first priority in Nebraska statutes, followed is given first priority in Nebraska statutes, followed by agricultural use, and last, industrial use. To resolve the conflict, pumping and recovery tests were done, and the irrigation well was deemed responsible for the head decline. The court ordered that the plaintiff be reimbursed for the less costly of two options--lower the existing domestic well levels or connect to city water. As a result of this conflict, legislation has been introduced that would recover wells of his professors (deserted). would require wells of high preference (domestic) to be reasonably deep and well-constructed if wells of lower preference are to be held liable for head loss. (Cassar-FRC) W81-03783

# AROUND THE WORLD WITH CHARLIE SENN, C. I. Senn

L. Senn Journal of Environmental Health, Vol 43, No 4, p 206-207, January/February, 1981.

Descriptors: \*Developing countries, \*Environmental sanitation, Public health, Water quality management, Water pollution control.

An environmental health consultant, C. L. Senn, has worked in developing nations for the World Health Organization and has made observations on sanitation conditions in several countries. In the Phillippines, the general trend is toward the use of stabilization ponds to replace discharge of raw sewage into streams or seas. Also, the reuse of water for fish raising and irrigation is encouraged. Education of the people so that they will accept toilets and other modern ways has been an impor-tant factor in the Phillippines. In Sumatra, a master plan is being developed for the largest city, Medan, which presently has no sewers. In rural areas dug water wells are being curbed to limit surface drain-age. In the New Hebrides Islands, one villager is being appointed in each village to be trained as a sanitarian. In Kenya, aqua privies are being en-couraged. In India, Gobar bio-gas generators are operating on 50,000 farms to produce light and heat from methane produced from animal manure. W81-03825

# SECOND PHASE OF THE INTERNATIONAL HYDROLOGICAL PROGRAM, National Research Council, Stockholm (Sweden).

Committee for Hydrology. M. Falkenmark. Ambio, Vol 10, No 1, p 48-49, 1981. 1 Fig.

Descriptors: \*Sanitary engineering, \*Potable water, \*Planning, Social aspects, Hydrology, United Nations, Foreign countries, Education, International Drinking Water and Sanitation Decade, Water policy, \*Developing countries.

At the Third Session of the Intergovernmental Council of the International Hydrological Pro-gram, plans for the Second Phase activities for gram, pians for the second rhase activities for 1981-1983 shifted to emphasis on the utilitarian importance of hydrology in support of water re-sources planning, development, and management. Activities will be less concerned with scientific research and more involved with transfer of knowledge to and between developing countries. (Cassar-FRC) W81-03842

# GROUNDWATER IS A NATURAL RESOURCE

National Research Council, Stockholm (Sweden). Committee for Hydrology. M. Falkenmark. M. Falkenmark. Ambio, Vol 10, No 1, p 49, 1981.

Descriptors: \*Groundwater, \*Aquifers, Water pollution control, Hydrology, \*Water policy, Planning, \*International commissions, Europe.

A round table discussion of the Council of Europe A round table discussion of the Council of Europe took place in Strasbourg in connection with the International Course on Environmental Law. It was organized by the Council's Working Group on the Rhine Phreatic Aquifer, the International Water Resources Association, and the International al Faculty of Compared Law. The major theme was the quantity and quality aspects of transfronwas the quantity and quality aspects of transfron-tier groundwater. The group concluded that groundwater is being accepted as a natural re-source by regional managers and hydrogeologists, but that the International Law Commission has not yet reached this viewpoint. Until this happens, proposed UNEP principles on shared natural re-sources do not apply. (Cassar-FRC) W81-03843

# NEEDED: A WATER STRATEGY FOR THE

M. Falkenmark, and C. Widstrand. Ambio, Vol 10, No 1, p 46-47, 1981. 2 Fig.

Descriptors: \*Water policy, \*International Drinking Water Supply and Sanitation Decade, Planning, Costs, Water supply, Sanitary engineering, Water pollution, International commissions.

Constraints and enhancing factors in the develop-Constraints and enhancing factors in the develop-ment of rural water supply and sanitation were discussed at a meeting organized by Uppsala Uni-versity, Sweden, and the U. N. Department of Technical Cooperation for Development. After water supplies are developed, the population must be educated to use the resource. Equipment must be maintained and repaired, and clean water sources must be protected from contamination. Cost estimates for achieving the goals for the In-ternational Drinking Water and Sanitation Decade were estimated at up to \$600 billion for the 10 year ternational Drinking water and Santation Decade were estimated at up to \$600 billion for the 10 year period. Although it is unrealistic to believe that all the far-reaching goals will be reached in this short time, it is hoped that general awareness of problems will develop, followed by increased priority given to water and sanitation on the local levels, especially in the developing countries. (Cassar-FRC) W81-03844

# CLEAN WATER COMES FIRST,

DC. Office of Drinking Water.
V. J. Kimm.

Water and Sewage Works, Vol 127, No 1, p 10, January, 1980.

Descriptors: \*Legislation, \*Drinking water, \*Public health, Economic aspects, Carcinogens, Regulations, Safe Drinking Water Act.

Legislative attempts to ease drinking water regula-tions are questioned. The Gramm amendments (HR-4509) would change the burden of proof in setting standards, suspend standards that have been on the books for almost 20 years, reduce measures to limit human exposure to carcinogens, and pro-vide a loop-hole for oil- and gas-exploitation relat-ed ejection wells. These amendments are attempts ed ejection wells. These amendments are attempts to avoid excessive government regulations and unnecessary increases in utility bills. It was the unequivocal intent of the Congress in the Safe Drinking Water Act to protect the public health. EPA has responded to this intent by controlling trihalomethanes in drinking water to provide public health protection to the vast majority of Americans, who use public water. EPA is also investigating other potential problem chemicals: trichloroethylene, carbon tetrachloride, tetrachloroethylene, the issue of protecting public drinking water is The issue of protecting public drinking water is more complex than it was a few years ago. Economic impact, cost-benefit analysis, and energy issues must now be considered when implementing the Safe Drinking Water Act. (Small-FRC) W81-03879

# INTERNATIONAL TRENDS IN WATER MAN-

AGEMENT. Effluent and Water Treatment Journal, Vol 20, No 11, p 538-540, November, 1980.

Descriptors: \*Water quality control, Rivers, Lakes, Sewage, River basin development, River basins, Groundwater basins, \*Water management, Surface water, Groundwater, Water pollution con-

The importance of national measures for controlling water pollution becomes evident when one considers international rivers such as the Rhine. Considerable interest is appearing in the develop-ment of models that permit predictions to be made of the effects of installing or improving wastewater treatment facilities at different locations within the system. Studies have also been made of algal blooms in various lakes, attributed to sewage effluent. Alum treatment has been used to remove phosphate from the effluent in some cases. The importance of urban stormwater as a source of nitrogen and phosphorus and the availability of these potential nutrients for the growth of algae in an area where stormwater is the major contributor to eutrophic conditions has also been examined. A study on groundwater quality was performed be-

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cause of the potential public health hazard caused by nitrates derived from septic tank leaching sys-tems contaminating groundwater taken for public supply. Each of these various studies is viewed from the viewpoint that the interactions of many variables affect the water quality, leading to the conclusion that the subject of water management must concern itself with these interacting variables. (Baker-FRC) W81-03880

# VIRGINIA RULING AFFECTS WATER WELLS,

L. J. Ross. Water Well Journal, Vol 34, No 10, p 43, October,

Descriptors: \*Municipal water, \*Water distribu-tion, \*Regulations, Well water, Legal aspects, Public opinion, Public health, Virginia, Virginia Beach.

Virginia Beach, Virginia, has a regulation which requires all buildings housing humans to which water service is made available, to attach to that water line within one year. A connection to the water service is required even if the homeowner continues to use his own well for a water supply. The regulation was passed in order to help the water system expand. Homeowners not wishing to be forced to pay for water service connection be toted to pay for water service connection brought suit against the city. The courts sided with the city because the city is charged with the broad responsibility of protecting the health, safety, and welfare of the people. The city argued that the wells could become polluted in the future, that a decline in the water table could make the wells inoperable, and a significant drawdown of ground water might cause salt water intrusion. If the city controls the water, it can protect the public health and enforce necessary conservation measures. Residents are expected to appeal the case to the US Supreme Court. (Small-FRC)

# CARL CAHILL/WATER WELL WARRIOR,

K. McCray. Water Well Journal, Vol 34, No 10, p 44-48, Octo-

Descriptors: \*Municipal water, \*Water distribu-tion, \*Regulations, Well water, Concrete pipes, Asbestos cement, Law enforcement, Water supply.

A resident of Chesapeake, Virginia, is fighting the city's mandatory connection ordinance. The primary reason for his fight is the fact that the city expanded its water system with pipe made of con-crete and asbestos. The people of the community had voted to expand the water system, but the mau voted to expand the water system, but the mandatory connection ordinance was not on the books at the time of the election, nor had the asbestos containing pipe been purchased. Only the manufacturer of the pipe will state that it is safe to use; most experts simply say that they are not sure. Cahill is taking his complaint to the US Supreme Court. (Small-FRC)

# SUMMARY OF STATE WELL CONSTRUCTION REGULATION AND ENFORCEMENT. Water Well Journal, Vol 34, No 10, p 52-54, October, 1980. 1 Tab.

Descriptors: \*Well drilling, \*Regulations, \*Law enforcement, Professional personnel, State jurisdiction, Licensing, Standards.

A chart is provided which analyzes state and local regulations governing the licensing of contractors and the regulation of well construction practices. The legislation's adequacy is analyzed, and the compatibility of state and local laws is evaluated. The extent of enforcement by regulatory authorities is indicated. Each state of the union is included. The chart is based on data compiled in 1979 by Tyler E. Gass and Joseph Ritchey of the National Water Well Association. (Small-FRC) W81-03884

# CONSTRUCTION GRANTS' PROCEDURES FLOW CHART EXPLAINED, ESEI, Detroit, MI. For primary bibliographic entry see Field 9D. W81-03908 PROCEDURES

# PLANASA - THE NATIONAL PLAN OF BASIC SANITATION.

National Housing Bank (Brazil). Sanitation Financing System Managing Office. I. M. Pires.

Aqua, No 9/10, p 195-198, 1980.

Descriptors: \*Sanitation, \*Planning, Water quality control, \*Brazil, Quality control, Resources management, Resources development, Water supply, Sewer systems.

The workings of the National Plan of Basic Sanitation (PLANASA) in Brazil are reviewed. PLANASA made possible a mobilization of efforts and resources that had not previously been available in the country. PLANASA called for the setting up of models of planning, execution and control. By establishing such models, it became easier to perform works calling for coordination of efforts. The level of competence of each of the organs involved was also more easily evaluated. Many solutions to problems have been met through this approach. Intensive activities for technological development have been in progress in the areas of water rehave been in progress in the areas of water re-sources research. A complete system of inventories detailing the demand of materials has been devised to enable the smooth implementation of activities.

# COMPARISON OF STANDARDS: HOW TO CHOOSE. (COMPARAISON DES NORMES: LESQUELLES CHOISIR.), Societe Lyonnaise des Eaux et de l'Eclairage

(France).

F. Fiessinger Aqua, No 9/10, p 199-207, 1980. 2 Tab, 5 Ref.

Descriptors: \*Water quality standards, \*Interna-tional agreements, Standards, Water quality, Water quality control, Quality control, \*Comparison

Standards of potable water quality differ in different countries. While it may be assumed that the ent countries. While it may be assumed that the water quality objectives in each country are dependent on the level of economic development, this is misleading. It is urged that water quality objectives and therefore standards should be the same in all nations around the world, with perhaps some differences allowed in their applicability. An example of what the standards should include is offered by the E.E.C. project. Parameters indicative of short-term risk are still emphasized, but new parameters for substances harmful in the long term, such as general organics, are also considered in this parameters for soustances minimum the rong term, such as general organics, are also considered in this program. The importance of treatment practices exceeds the importance of individual parameters' values. International cooperation is absolutely necessary in efforts to establish international standards. W81-03919

# PUMP INSTALLER REGISTRATION AND LI-

Water Well Journal, Vol 34, No 10, p 56-60, October, 1980, 1 Tab.

Descriptors: \*Well drilling, \*Regulations, \*Licensing, Professional personnel, State jurisdiction, \*Pumps, Installation, Standards.

A state-by-state listing of pump installer registra-tion and licensing required in the United States is presented. The type of requirement is noted, along with the legal citation or reference to the appropri-ate law. Regulation of pump installers is utilized by the states to protect residents from substandard workmanship and business practices. Most states impose at least one of these requirements on com-panies performing water well drilling services. Also, a majority of states now regulates drillers or others who work on or install well water supply

systems. This data was collected by the Legislative and Environmental Services Division of the National Water Well Association. (Small-FRC) W21\_03924

# FUNDING-AN EVAPORATING RESOURCE, C. P. Sapinsky. Water and Wastes Engineering, Vol 17, No 6, p

24-26, June, 1980.

Descriptors: \*Economic aspects, \*Water pollution control, \*Water quality management, Management planning, Wastewater treatment, Wastewater facilities, Government finance, Government supports, Grants, Hazardous materials, Groundwater.

Inflation and government budget cuts are major concerns for everyone involved in water pollution control during the 1980s. Excerpts from remarks made by several participants at the Water Pollution Control Federation (WPCF) Government Affairs Seminar held in early 1980 provide insights into current thinking with respect to where funding will come from, how much there will be, who will get it, and how it will be spent. Richard A. will get it, and now it will be spent. Richard A. Pavia provided suggestions for alleviating such problems as red tape, construction delays, future difficulties in obtaining funding from the Environmental Protection Agency (EPA), and unsatisfactory performance of wastewater treatment facilities. Richard Dougherty addressed deficiencies in ties. Richard Dougherty addressed deficiencies in the implementation of the Clean Water Act by EPA, including the overlapping responsibilities of the State and Federal governments in the construction grants program, he need for a river monitoring program, and the need to eliminate the open specifications policy. Eckardt C. Beck, of the EPA, discussed the need to refine and coordinate existing programs, to develop an integrated and comprehensive management strategy, and to develop systems for safely disposing of toxic substances and pollutants isolated from waterways. The need for a comprehensive groundwater strategy was also discussed. Congressman Norman Y. Mineta discussed the potential effects of budget cuts on the Water Pollution Construction Grants Program. (Carroll-FRC) (Carroll-FRC) W81-03932

# SOME PROGRAMS GOVERN U.S.-CANADIAN HAZARDOUS WASTE DISPOSAL.

Water and Wastes Engineering, Vol 17, No 2, p 55, February, 1980.

Descriptors: \*Legislation, \*Canada, \*Waste disposal, Great Lakes Water Quality Agreement, Chemical wastes, Resource Conservation and Recovery Act, Toxic Substances Control Act, Environmental Contaminants Act, Governments, Water policy, Water Jaw, Water poliution control, Water quality, Disposal, Hazardous materials, Polychlorinated biphenyls, \*International agreements

Hazardous waste disposal is regulated by programs in the U.S. and Canada. The U.S. Toxic Substances Control Act (1976) bans PCBs from all but totally enclosed uses. It empowers the EPA to regulate many aspects of chemical substances and mixtures. The U.S. Resource Conservation and Recovery Ine U.S. Resource Conservation and Recovery Act (1976) regulates treatment, storage, transporta-tion, and disposal of hazardous wastes which can adversely affect health and the environment. Can-ada's Environmental Contaminants Act (1975) reada's Environmental Contaminants Act (1975) requires mandatory reporting for manufacture of new chemicals or new applications for existing ones. Manufacturers and users of PCB, mirex, and certain other halogenated hydrocarbons are required to report to the Minister of Environment. A joint agreement, the U.S.-Canada Great Lakes Water Quality Agreement (1978), regulates hazardous waste disposal, research on nature and effects of toxic substances, derivation of mathematical models, and development of a data bank for information on chemical properties, toxicity, and uses. (Cassar-FRC)
W81-03949

# FEDERAL INDUSTRIAL PRETREATMENT PROGRAM: WONDERLAND REVISITED, Black and Veatch, Kansas City, MO.

## Field 6-WATER RESOURCES PLANNING

# Group 6E-Water Law and Institutions

For primary bibliographic entry see Field 5D. W81-03950

# 6G. Ecologic Impact Of Water Development

STATUS OF THE ENVIRONMENTAL AND WATER QUALITY OPERATIONAL STUDIES (EWQOS) PROGRAM,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. For primary bibliographic entry see Field 5G. W81-03643

LAKE PONTCHARTRAIN WATER QUALITY

STUDIES, Tulane Univ., New Orleans, LA. For primary bibliographic entry see Field 7A. W81-03648

WATER QUALITY EVALUATIONS - TENNES-SEE-TOMBIGBEE WATERWAY, AN OVER-VIEW.

VIEW, Army Engineer District, Mobile, AL.
N. D. McClure, IV.
In: Proceedings of a Seminar on Water Quality
Evaluation, 22-24 January, 1980, Tampa, Florida.
Army Corps of Engineers, Committee on Water
Quality, Washington, DC., paper 11. 10 p. 1 Fig,

Descriptors: \*Water quality, \*Waterways, \*Environmental effects, Ground water, Surface water, Erosion control, Canals, Flow control, Construction, Reservoirs, \*Tennessee-Tombigbee Waterway.

The Tennessee-Tombigbee Waterway (Tenn-Tom) The Tennessee-Tombigbee Waterway (Tenn-Tom) provides an alternative transportion mode by connecting two existing waterways: the Tennessee River on the north and the Black Warrior-Tombigbee on the south. It is 232 miles long with 10 impoundments, and a project of this magnitude involves a number of diverse water quality considerations. The Divide Section involves extensive erosion control measures, the interaction of ground and surface waters water the transfer of water forms. and surface waters, and the transfer of water from the Tennessee River to the Tombigbee Basin. The primary water quality considerations in this section are related to the distribution of flow between the canal and the East Fork to insure a favorable flow regime in both water bodies. In the River Section, the primary considerations relate to the disposal of excavated material and the changes in assimilative capacity of the water bodies. The water quality studies are actually a component of the overall continuing environmental studies for the waterway which are being accomplished in three phases: assessment of anticipated impacts; collection of additional data with the objectives of minimizing adverse environmental impacts and maximizing en-vironmental protection while seeking measures for enhancement; and further monitoring during construction and post impoundment investigations after the waterway is in operation. The water quality evaluations for the Tenn-Tom have been underway for almost ten years and will continue for a number of years. (Moore-SRC) W81-03650

KISSIMMEE RIVER STUDY,

Army Engineer District, Jacksonville, FL. J. Dryden.

J. Drygen. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 12. 6 p.

Descriptors: \*Flood control, \*Water quality, \*Environmental effects, Wetlands, Wildlife, Recreation, Economic aspects, Channelization, Social aspects, Public participation, Drainage, Navigation, Resources management, \*Kissimmee River basin, Florida.

The Kissimmee River Basin drainage area is 3,013 square miles in south central Florida and is adjoined on the east by the Taylor Creek-Nubbin

Slough Basin which is about 200 square miles in size. Both of these basins are tributary to Lake Okeechobee. The main emphasis of projects in this area has shifted, over the years, from drainage and channelization for flood control to water quality and environmental considerations. During the first and environmental considerations. During the lirst stage of the Kissimmer River Study, considerable importance was placed on public involvement. The initial public involvement has resulted in the prepa-ration of a comprehensive list of public concerns-stabilized water levels; loss of wetlands; loss of fish stabilized water levels; loss of twettands; loss of itsh and wildlife resources; degraded water quality; flood damage potential; loss of recreational and esthetic values; potential inadequate water supply; and potential loss of navigation capabilities. In and potential loss of navigation capabilities. In order to accurately assess the impacts of each alternative proposed, spatial analysis methodology will be used for data management. This will enable the comparison of environmental, economic, and hydraulic consequences for each alternative. The ongoing environmental studies also include water quality analysis efforts. The Kissimmee River study offers an excellent opportunity for innovative and new planning techniques especially for environmental enchancement. Selection of a recommended plan will be based on subjective as well as objective comparison of intangible environment as objective comparison of intangible environmen-tal considerations and economic considerations. (Moore-SRC) W81-03651

PLANASA - THE NATIONAL PLAN OF BASIC

FLANDASA - THE NATIONAL FLAN OF BASIC SANITATION, National Housing Bank (Brazil). Sanitation Financ-ing System Managing Office. For primary bibliographic entry see Field 6E. W81-03916

# 7. RESOURCES DATA

# 7A. Network Design

QUALITY NETWORKS: STRATEGIES FOR THE CORPS OF ENGINEERS, Army Engineer Div. North Pacific, Portland, OR. M. Koryak.

In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 5. 14 p, 7 Fig, 1

Descriptors: \*Water quality, \*Network design, \*Sampling, \*Monitoring, Rivers, Watersheds, Flow rate, Indicators, Water pollution, Site selec-

The design of water quality monitoring networks has traditionally been a subjective process. Decisions as to the number of stations in a network, station locations, sampling frequencies and param-eter coverage are based primarily on the judgeeter coverage are based primarily on the judge-ment of the individual designers, but interest has developed in more rational criteria for the system-atic design of water quality monitoring networks. Before designing a system, it is essential to attempt to define the desired objectives. A monitoring system matrix can be helpful in allocating re-sources and in establishing a monitoring strategy appropriate to specific purposes. For the selection of monitoring stations a controid technique can be appropriate to specific purposes. For the selection of monitoring stations, a centroid technique can be used to systematically subdivide river networks into portions which are relatively equally weighted in terms of any chosen criteria. However, the traditional monitoring locations may generate more meaningful information than the centroid technique. Sampling frequency depends on the size of the water quality monitoring effort. Parameter selection is perhaps more difficult to generalize upon than any other aspect of monitoring network design. Usually the choices that must be made are self-evident or site specific. Most chemicals in aqueous solution tend to occur in aggregate groups, which makes it possible to facilitate water quality reconnaissance and to refine sampling schedules by using indicator parameters. (Moore-SRC) W81-03644

LAKE PONTCHARTRAIN WATER QUALITY STUDIES,
Tulane Univ., New Orleans, LA.

Julane Univ., New Orleans, LA.
C. Grimwood, and B. J. Thibodeaux.
In: Proceedings of a Seminar on Water Quality
Evaluation, 22-24 January, 1980, Tamp, Florida.
Army Corps of Engineers, Committee on Water
Quality, Washington, DC., paper 9. 6 p.

Descriptors: \*Water quality, \*Network design, \*Monitoring, Baseline studies, Estuarine environment, Water sampling, Cost analysis, Flood control, Navigation, \*Lake Pontchartrain, Louisiana.

In the planning, development and operation of Corps of Engineers projects in Lake Pontchartrain, Louisiana, the acquisition and processing of water quality data are essential to quantify existing conditions, forecast future trends and project changes that may come about as a result of the implementation of flood control and navigation projects. The water quality monitoring networks in Lake Pont-chartrain have been successful in accomplishing the objectives for which they were designed. The data collected by the baseline monitoring network have resulted in a documented assessment of background water quality conditions in the lake. Periodic review of these data has resulted in improvements to the network by relocating stations that do not show significant variations in water quality to more dynamic locations. In addition, the frequency of water sample collection has been reduced from more dynamic locations. In addition, the frequency of water sample collection has been reduced from two to one sample per month as the data collected indicated that the reduction in sampling frequency was justified. The water quality monitoring program in Lake Pontchartrain has shown that frequent data review is essential to the maintenance of an adequate and cost effective water quality sam-pling network. (Moore-SRC) W81-03648

EXPANDING COMPUTER APPLICATIONS TO REDUCE ENERGY CONSUMPTION, Greeley and Hansen, Philadelphia, PA. For primary bibliographic entry see Field 5F. W81-03755

ONE APPROACH TO COMPUTERIZED OP-

ERATION,
Dallas City Water Utilities Dept., TX.
M. K. Tubbs.

Journal of the American Water Works Association, Vol 73, No 3, p 128-129, March, 1981. 2 Tab.

Descriptors: \*Specifications, \*Control systems, \*Data acquisition, Operating policies, On-site data collections, Digital computers, Computer programs, Water treatment, Contracts, \*Dallas, Texas.

The approach used by the Dallas Water Utilities in specifying and purchasing a data acquisition and control system is outlined. A project team comprised of data processing and computer systems experts and those who were responsible for the experts and those who were responsible for the operation of the water system drew up performance specifications. Then, each bidder was responsible for proposing a system which would comply with the specifications. This allowed each bidder to take advantage of his experience in software and hardware technology relevant to the system. The final sensitionations are divided into threes nets. hardware technology relevant to the system. The final specifications were divided into three parts. Section 1 specified the format of the bidders' proposals. Each bidder was required to make a formal presentation. Section 2 detailed the technical performance requirements for the system. Section 3 set forth the general specifications regarding conduct of the work, bonding, and payment that accompany all city contracts. The final system was well designed to meet the needs of the Dallas Water Utilities and provide for personnel training. (Small-FRC) (Small-FRC)

THE COMPUTER AS A TOOL FOR MEETING FUTURE DEMANDS,

Atlanta Bureau of Water, GA.
T. E. Stallworth, Jr.
Journal of the American Water Works Association, Vol 73, No 3, p 130-131, March, 1981.

# Data Acquisition—Group 7B

Descriptors: \*Digital computers, \*Control systems, \*Data transmission, Water treatment, Electric power demand, Data processing, On-site data collections, Computer applications, \*Atlanta, Geor-

The Atlanta water system has installed a dual-computer system to monitor the 600 sq mi distribu-tion network, control remote pumping stations, and reduce costs through an energy management program. The computer system, CASPER (Com-puter Analysis of System Pumpage and Energy Reduction), is located in the load control center. Pressure in the distribution system is monitored by CASPER at 70 locations, and two potable water pump stations are completely controlled by CASPER aided by remote terminal units. Special CASPER aided by remote terminal units. Special power demand meters that will telemeter electrical consumption from designated stations to the computer have been purchased, and daily load curves will be developed to see how the electrical load cycle varies. The computer will forecast when current power demand rates are likely to be exceeded so studies can be initiated to decrease power demand. CASPER also reports each hour on the amount of water available in each reservoir, and provides the operator with total water gained or lost since the beginning of each shift. These data can be used for plotting trends. The system uses two cathode ray terminals, a high-speed printer, and a digital event printer. (Small-FRC) W81-03798

COMPUTER ADMINISTRATION: AHEAD AND STAY AHEAD, San Antonio City Water Board, TX. J. R. Shields, and R. M. Hackett. PLAN

Journal of the American Water Works Association, Vol 73, No 3, p 132-135, March, 1981.

Descriptors: \*Data storage and retrieval, \*On-site data collections, \*Systems analysis, Computer programs, Future planning, Data processing, Digital computers, Water treatment.

Computerized systems can enhance administrative Computerized systems can enhance administrative control over basic water utility operations and also reduce costs. Careful, advance planning of system design is important for success. It is a good idea to allow for the inclusion of information of doubtful value when the system is initially planned, as modifying programs at a later date to process more information is costly. For example, a system may be designed to compute and print paychecks and compile information necessary to meet federal regulations concerning social security and taxes. It is possible that a report categorizing this information by task performed will be useful for the administration. During original system design the information tor. During original system design, the information on tasks must be collected and stored. Computer on tasks must be collected and stored. Computer storage of additional information is usually cheaper than modification of programs and the files they access. The city of San Antonio, Texas, maintains a general information bank to control the billing and collection of sewer and water service. Administrative control over the accuracy of meter readings and meters is obtained through exception reports. Each month, the information bank is stored on magnetic tape, making future summary management reports possible. (Small-FRC) W81-03805

# 7B. Data Acquisition

URBAN LAWN IRRIGATION AND MANAGE-MENT PRACTICES FOR WATER SAVING WITH MINIMUM EFFECT ON LAWN QUAL-

Colorado State Univ., Fort Collins. Dept. of

Agronomy. R. E. Danielson, C. M. Feldhake, and W. E. Hart. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215642, Price codes: A07 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Colorado State University Completion Report 106, April, 1981. 120 p. 18 Fig. 7 Tab. 17 Ref. 8 Append. OWRT-A-043-COLO(2), 14-34-0001-

Descriptors: \*Water conservation, \*Lawns, Landscaping, Sprinkler irrigation, Urbanization, Water use, Water management, \*Irrigation efficiency, Evaluation, Evapotranspiration, Controlled tests

Evaluation, Evapotranspiration, Controlled tests.

Understanding the response of turfgrass to water and energy is critical in semiarid regions where energy for evaporation is high and water is often in short supply. During the summers of 1979 and 1980 research was conducted at Colorado State University to help in planning efficient urban lawn irrigation techniques. Forty-eight small bucket-type weighing lysimeters were used to measure the effect of various management practices on maximum water use and the response of turf quality to limited irrigation levels. Maximum water use was influenced by mowing height, nitrogen fertility, shade level, grass specie, and to a slight degree, soil properties. Nitrogen-deficient grass showed a linear decrease in visual quality with decrease in irrigation; adequately fertilized grass, however, had minimal reduction in quality when irrigation was decreased to 70% of that required for maximum evapotranspiration (ET), and a rapid decrease with further irrigation decrease. Shade studies showed that ET increased linearly with inciies showed that ET increased linearly with inci-dent radiation and all treatments had a constant advective component of ET which averaged 30% of the water used by the full sun treatment. Grass under water stress had a canopy temperature 1.7C higher for each 10% decrease in ET below maximum. mum on sunny days. W81-03604

# COLLECTION OF REPRESENTATIVE WATER OUALITY DATA FROM MONITORING QUALITY WELLS,

Illinois State Water Survey, Peoria J. P. Gibb, R. M. Schuller, and R. A. Griffin. Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: A12 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, Pennsylvania, Shultz, D. W., Ed., EPA Report EPA-600/981-002a, March, 1981, p 126-137. 7 Fig, 1 Tab, 5

Descriptors: \*Monitoring, \*Wells, \*Water quality, \*Water sampling, Sample preservation, Pumping tests, Geohydrology, Groundwater, Chemical properties, Pumps, Sample preparation, Field tests.

Monitoring wells at six sites of widely varying geologic and hydrologic conditions were selected to study monitoring well sampling and preservation techniques. The goal was to develop a sampling protocol that would yield water samples that are representative of the aquifer being sampled. The effects of four pumping mechanisms, time and rate of pumping, well flushing, and preservation techniques on the water quality of the collected samples were studied. Pumping tests and multiple sampling experiments provided data on which recommended sampling protocols and sample preparation, preservation, and storage procedures are based. The size and accessibility of the individual well, its hydrologic and chemical character, the chemical constituents of interest, and the purpose chemical constituents of interest, and the purpose for monitoring all affect the selections of the pumping mechanism and procedures for sample collection. Chemical parameters, including PH, Fe, and Zn, are more sensitive to the above variables than other parameters. Recommended sampling than other parameters. Recommended sampling procedures are as follows. Conduct a pump test to determine hydrologic properties on which to base sampling frequencies, and time and rate of pumping prior to sampling. Use a peristaltic or submersible diaphragm type pump when site location permits. Use a bailer in more remotely located well as the company of the process of the control sites. Measure pH, specific conductance, oxidation-reduction potential, and alkalinity at the time of sample collection. Make field measurements in a closed cell that does not expose the sample to crosed cell that does not expose the sample to atmospheric conditions. Filter samples through a 0.45 micrometer pore sized membrane immediately after collection. Store and preserve samples ac-cording to the U. S. EPA (1979) recommended protocols. (Author's abstract) W81-03636

COASTAL SAMPLING PROGRAM DESIGN, Army Engineer District, Wilmington, NC. R. Jackson. In: Proceedings of a Seminar on Water Quality Evaluation, 22-24 January, 1980, Tampa, Florida. Army Corps of Engineers, Committee on Water Quality, Washington, DC., paper 6. 7 p.

Descriptors: \*Coasts, \*Estuaries, \*Water quality, \*Sampling, Baseline studies, Monitoring, Planning, Surveys, Coastal areas, \*Network design.

The procedures for designing a water quality survey in coastal areas consist of the following steps: define the objectives; collect background data; prepare preliminary plans; conduct field reconnaissance; and prepare the final plan. There are some special concerns in sampling program design for coastal areas. One of these is tides, which may for coastal areas. One of these is tides, which may interfere with station access, force rivers to flow upstream, and make navigation treacherous. Seawater can interfere with standard tests, and corrosion is always important in coastal areas. Strong coastal storms can make sampling impossible. It is also necessary to be aware of seasonal occurrence or passage of biological species involved in the sampling effort. A conscientious effort, following these five steps and being aware of special concerns or precautions for the coastal areas, can result in an excellent program that will provide meaningful data within a cost effective framework. (Moore-SRC)

ESTIMATION OF THE TRANSMISSIVITY OF THIN LEAKY-CONFINED AQUIFERS FROM SINGLE-WELL PUMPING TESTS, British Petroleum Co. Ltd., London (England). For primary bibliographic entry see Field 2F. W81-03723

PERFORMANCE ASSESSMENTS OF PRECIPI-TATION GAGES FOR SNOW MEASURE-

Univ., Laramie. Water Resouces Research Inst

search Inst.
P. A. Rechard, and T. C. Wei.
Available from the National Technical Information
Service, Springfield, VA 22161 as PBB-1218347,
Price codes: AØ9 in paper copy, A01 in microfiche.
Water resources Series No 76 (September 1980).
195 p, 9 Fig, 10 Tab, 17 Ref, 10 Append. OWRT
A-015-WyD(3), 14-31-0001-4051,5051,6053, 14-340001-7108,8054,9054.

Descriptors: \*Hydrologic instruments, \*Precipita-tion gages, \*Snow gages, Snow accumulation, Measuring instruments, Testing procedures, Per-formance evaluation, Precipitation gage shields, Wind shields, Wyoming shield.

Snow measurement with a precipitation gage is affected by snow properties, air turbulence, and gage configuration. Various shields are used to reduce the effects of these factors and to improve gage collinguistation. Valuous stitleds are dead to the reduce the effects of these factors and to improve the catch performance of the gage. In this investigation, comparisons were made of the following gages and shields: the Belfort weighing-recording gage without a shield, with an Alter shield, with a restrained Alter shield, with a Low Wyoming shield, and with a Raised Wyoming shield; a Russian gage with and without Tetyakov shields and with a restrained Tretyakov shield; a Swedish gage with and without a shield; the Fischer and Porter gage with a modified shield. In Addition, Hamon's proposed dual-gage approach was tested and the effects of wind speed and air temperature on the gage catch were analyzed. Precipitation measured by an Alter-shielded gage in a forest opening was used as the standard catch. The catch by the Raised-Wyoming-shielded gage was found to be free from wind effects and to correlate well with the standard catch. All gages without shields of any kind performed very without shields of any kind performed very poorly. Other gage performances fell between these two extremes.

THE PERFORMANCE OF A MODIFIED CO-SHOCTON-TYPE RUNOFF SAMPLER.

# Group 7B-Data Acquisition

Agricultural Extension Service, Stillwater, OK. Water Conservation Structures Lab. For primary bibliographic entry see Field 2A.

EVALUATION OF AUTOMATIC CONTOUR-ING METHODS FOR DRAINAGE DESIGN, Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.

R. Kok, and J. Begin.
Transactions of the ASAE, Vol 24, No 1, p 87-96,
January-February, 1981. 7 Fig. 5 Tab, 35 Ref.

Descriptors: \*Contours, \*Mapping, \*Computers, Computer programs, Geologic mapping, Topographic mapping, Economic aspects, \*Drainage terrace, Drainage design.

A computer contouring package was written containing three gridding methods and one contour-drawing method. Of the three gridding methods, weighted average and finite difference gridding performed adequately. Trend-surface analysis was performed adequately. Trend-surface analysis was unsuitable. Contour maps were generated of four real and three mathematical surfaces. The quality of computer contouring was superior to that of contouring by humans under ordinary circumstances. The accuracy was measured by means of a novel method of comparing drawn contours with ideal contours. The accuracies of the weighted average and finite difference gridding methods followed by automatic contour drawing were not significantly different from those of four experienced draftsmen. The cost of computer contouring enced draftsmen. The cost of computer contouring was lower than that of human performance and potentially could be much lower under commercial production conditions. The computer can draw contour maps of higher quality at a lower cost in a fraction of the time required. (Baker-FRC) W81-03764

ALTERNATIVE METHOD FOR EVALUATING COST-EFFECTIVE FILTER PERFORMANCE.
Journal of the American Water Works Association, Vol 73, No 3, p 28, March, 1981. 1 Fig.

Descriptors: \*Filters, \*Measuring instruments. \*Cost analysis, Performance evaluation, Water treatment facilities, Water treatment.

A method for evaluating filter media performance at water treatment plants without installing expen-sive manometer systems was developed in order to avoid the installation of pressure taps through an 18-inch thick concrete wall at the Santa Clara 18-inch thick concrete wall at the Santa Clara Valley Water District's treatment plant at Rinconada, California. The probe can be conveniently operated from the deck above a filter to monitor head loss at selected points within an operating filter. The system components include a number of plastic tubes and PVC pipes installed at preselected depths within the filter media, a vacuum pump, and a series of manometers. The probe system and a series of manometers. The proof system allows rapid evaluation of filter media performance characteristics, rapid deduction of such filter media problems as surface straining, sampling of water from within the filter, and evaluation of filter media turbidity removal characteristics. (Carroll-ERC) FRC) W81-03803

VERSATILE COMPUTER CONTROLS ATLAN-TA WATER DISTRIBUTION, Atlanta City Bureau of Water, GA. For primary bibliographic entry see Field 5F. W81-03942

# 7C. Evaluation, Processing and Publication

TEMPERATURE LOGS OF WELLS AND TEST WELLS IN THE YUMA AREA, ARIZONA AND CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div. F. H. Olmsted.

Geological Survey Open-File Report 80-335, March 1980. 300 p, 1 Fig, 1 Plate, 1 Tab.

Descriptors: \*Water temperature, \*Logging(Recording), \*Wells, Drill holes, Maps, Test wells, Data collections, \*Arizona, \*California,

This report consists of 310 temperature logs made This report consists of 310 temperature logs made in 266 wells and test wells in the Yuma area, Arizona and California during 1963-69. The work was done as part of a geohydrologic study, the results of which are reported in the 1973 U.S. Geological Survey Professional Paper 486-H; Geohydrology of the Yuma Area, Arizona and California, by Olmsted, Loeltz, and Irelan. Most of the logs are plotted from temperatures measured with two Whitney thermistors at depth intervals of 2 to 20 feet in downward succession in each well or test bole, using land surface as datum. A few logs were made with a truck-mounted wireline logger using thermistor probes and continuously recording equipment. All measurements were in degrees Fahrenheit, later converted to degrees Celsius, and were calibrated with a mercury-in-glass thermom-eter. Accuracy of most of the measurements was + or - 1.0F and precision was about + or - 0.2F.

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1980--VOLUME 2. LONG

Geological Survey, Syosset, NY. Water Resources

Available from the National Technical Information Avanaue from the National reclinical monthation Service, Springfield, VA 22161 as PB81-211484, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NY-80-2, 1980. 344 p, 8 Fig., 1 Tab.

Descriptors: "Hydrologic data, "Surface water, "Groundwater, "Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, "New York, "Long Island.

Water resources data for the 1980 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water quality of precipitation; and water levels and water quality of ground water wells. This volume contains reoriginal water webs. This volume contains re-cords for water discharge at 17 gaging stations; water quality at 17 gaging stations, 602 wells, and 3 precipitation stations; and water levels at 128 ob-servation wells. Also included are data for 80 lowflow partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program, and are pub-lished as miscellaneous measurements and analyses. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey in cooperation with State, Federal, and other agencies in New York. (USGS) W81-03730

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUAD-RANGLES, MISSISSIPPI, Geological Survey of Alabama, Montgomery. Water Resources Div.

Water Resources Div.
L. R. Bohman, and J. C. Scott.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$2.00. Geological Survey Hydrologic Investigations Atlas
HA-622, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, \*Mississippi, Gulf Coast, \*Kreole-Grand Bay SW Quadrangles.

Shown on a topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along coastal areas of Mississippi Sound from about one mile east of the Alabama-Mississippi State line

westward to the Jackson County Airport in Missis-sippi. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Tide elevations in this region were about equal to those produced by Hurricane Betsy in September 1965. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama, a few miles southeast of Grand Bay. (USGS)

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, GRAND BAY QUADRANGLE, ALA-

Geological Survey of Alabama, Montgomery.
Water Resources Div.
L. R. Bohman, and J. C. Scott.
L. R. Bohman, and J. C. Scott.
L. R. Bohman, and J. C. Scott.

L. R. Bohman, and J. C. Scott. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$2.00. Geo-logical Survey Hydrologic Investigations Atlas HA-622, 1980. I Sheet, 4 Fig. 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water Level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, \*Mississippi, Gulf Coast, \*Grand Bay quadrangle

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the southern coast of Mobile County, Alabama, from the western section of the city of Bayou La Batre, Alabama, to approximately 13 miles east of Pasca-goula, Mississippi. Storm-tide frequency and re-Alabama, in approximately 15 mines east of Pasca-goula, Mississippi. Storm-tide frequency and re-cords of annual maximum tides at Mobile, Ala-bama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. The town of Bayou La Batte, Alabama, use extensively Gooded (USGS) Batre, Alabama, was extensively flooded. (USGS) W81-03734

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, CHICKASAW QUADRANGLE, ALA-BAMA,

BAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. L. R. Bohman, and J. C. Scott. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$2.00. Geological Survey Hydrological Investigations Atlas HA-623, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Chickasaw quadrangle.

Shown on a topographic map are floodmark elevashown of a opporation in an are incoming terms to said approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the western side of the Mobile River from about one mile north of Satsuma, Alabama, to Chickasaw, Alabama. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. Extensive wind damage occurred along the Mobile River in addition to minor flood damage to some houses and industrial complexes. (USGS) W81-03735

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, MOBILE QUADRANGLE, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. L. R. Bohman, and J. C. Scott. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$2,00. Geo-logical Survey, Hydrodic, Investigations, Atlas

logical Survey Hydrologic Investigations Atlas HA-624, 1980. 1 Sheet, 4 Fig, 1 Tab.

# Evaluation, Processing and Publication—Group 7C

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water Level, Sca level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast \*Mahile gunders descriptions of the Property of the P Coast, \*Mobile quadrangle.

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the western side of the Mobile River and Mobile Bay from Pritchard, Alabama, to the Forest Park section of Mobile, Alabama. Storm-tide frequency and records of annual maximum tides at Mobile, Ala-bama, since 1772, are presented. Offshore winds vama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. Most of the waterfront improvements in Mobile Bay were either destroyed or heavily damaged. (USGS) W81-03736

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, HOLLINGERS ISLAND-THEODORE QUADRANGLES, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div.

water Resources DIV.
L. R. Bohman, and J. C. Scott.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$2.00. Geo-logical Survey Hydrologic Investigations Atlas HA-625, 1980. 1 Sheet, 4 Fig. 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf coast, \*Hollingers Island-Theodore quadrangles.

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the western shore of Mobile Bay from the southern part of Mobile, Alabama, to the South Fork of Deer River including the inland areas along Deer River and Dog River. Storm-tide frequency and records of annual maximum tides at Mobile, Ala-bama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near of about 145 miles per hour was recorded near Dauphin Island, Alabama. Many homes and build-ings were severly damaged by flooding, tidal waves, and high winds. Most fishing piers, sea walls, or other waterfront improvements were destroyed or heavily damaged. (USGS)
W81-03737

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, CODEN-BELLEFONTAINE QUAD-RANGLES, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div.

Water Resources DIV.
L. R. Bohman, and J. C. Scott.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$2.00. Geo-logical Survey Hydrologic Investigations Atlas
HA-626, 1980. 1 Sheet 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Coden-Bellefontaine quadrangles.

Floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along coastal areas of Mobile Bay between Bellefontaine and Point Judith, Alabama, are shown on a topographic map. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A windstylective of about 145 miles per hour was snore winds reached about 100 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. Most of the waterfront improvements in Mobile Bay were either destroyed or heavily damaged. The town of

Bayou La Batre, Alabama, was extensively flooded. (USGS) W81-03738

HURRICANE FREDERIC TIDAL FLOODS OF HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, HERON BAY, LITTLE DAUPHIN ISLAND, FORT MORGAN, AND FORT MORGAN NW QUADRANGLES, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. L. R. Bohman, and J. C. Scott. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geo-logical Survey Wedelseis Leustinstins.

logical Survey Hydrologic Investigations Atlas HA-627, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Heron Bay, \*Little Dauphin Island, \*Fort Morgan, \*Fort Morgan NW, Quadrangles.

Shown on a topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the southeastern tip of Mobile County, including Dauphin Island, Alabama. Nearly all the mainland area shown on the map was inundated by the tidal surge. The Dauphin Island Parkway Bridge (Alabama State Highway 163) was almost totally demolished. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) Alabama. (USGS) W81-03739

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, THE BASIN, BAY MINETTE NORTH, AND CREOLA NE QUADRANGLES, ALA-BAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. L. R. Bohman, and J. C. Scott. Available from the Br. of Dist. JISGS 1200 S

Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geo-logical Survey Hydrologic Investigations Atlas HA-628, 1980. I Sheet, 4 Fig. 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal Goods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*The Basin, \*Bay Minette North, \*Creola NE Obadgrangles: NE, Quadrangles.

Shown on The Basin-Bay Minette North-Creola NE, Ala., topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the Mobile and Tensaw Rivers from Salco and Stockton southward to Creola and Upper Hall Landing, Ala. Minor flooding occurred in this region. Storm-tide frequency and records of annual maximum tides at Mobile, Ala., since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS)

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, HURRICANE QUADRANGLE, ALA-

COAST, HURRICANE QUADRAS AND A GEOLOGICAL SURVEY OF Alabama, Montgomery. Water Resources Div. J. C. Scott, and L. R. Bohman. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$2.00. Geological Survey Hydrologic Investigations Atlas HA-629, 1980. I Sheet, 4 Fig. 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-

pheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Hurricane quadrangle.

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the Mobile and Tensaw Rivers in Mobile and Baldwin Counties, Alabama. Most of the inundated areas shown are marshlands or flood plains of small tributary streams. Storm-tides frequency and re-cords of annual maximum tides at Mobile, Ala-bama, since 1772, are presented. Offshore winds oams, since 1772, are presented. Orising winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) W81-03741

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, BRIDGEHEAD QUADRANGLE, ALA-BAMA,

Geological Survey of Alabama, Montgomery. Water Resources Div. J. C. Scott, and L. R. Bohman.

Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$2.00. Geological Survey Hydrologic Investigations Atlas HA-630, 1980. 1 Sheet, 4 Fig. 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Bridgehead quadrangle.

Shown on a topographic map are floodmark eleva-Shown on a topographic map are Hoodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the Mobile Causeway (U.S. Highway 90) from the Tensaw River to Spanish Fort, Alabama, and the eastern shore of Mobile Bay in the vicinity of eastern shore of Mobile Bay in the vicinity of Spanish Fort. Most buildings and business establishments along Mobile Causeway were completely destroyed, and the remaining buildings were severly damaged by flooding. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS)

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, DAPHNE-POINT CLEAR QUADRAN-GLES, ALABAMA,

Geological Survey of Alabama, Montgomery. Water Resources Div.

water Resources DIV.

J. C. Scott, and L. R. Bohman.

Available from the Br. of Dist., USGS 1200 S.

Eads St. Arlington, VA. 22202, Price: \$2.00. Geological Survey Hydrologic Investigations Atlas

HA-631, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Di-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Daphne-Point Clear quadrangles.

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the eastern shore of Mobile Bay generally from Daphne, Alabama, southward through Fairhope and Point Clear to Mullet Point, Alabama. Build-ings and sewalls were damaged by flooding and tidal waves in the vicinity of Fairhope, Alabama. Most fishing piers along the shore were either tidal waves in the vicinity of Fairhope, Alabama. Most fishing piers along the shore were either destroyed or severely damaged. From Fairhope southward, many homes and other buildings, including the Grand Hotel complex at Great Point Clear, were severely damaged. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-

#### Field 7—RESOURCES DATA

# Group 7C—Evaluation, Processing and Publication

velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) W81-03743

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, MAGNOLIA SPRINGS QUADRAN-GLE, ALABAMA,

GLE, ALABAMA,
Geological Survey of Alabama, Montgomery.
Water Resources Div.
J. C. Scott, and L. R. Bohman.

Available from the Br. of Dist, USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas HA-632, 1980. I Sheet, 4 Fig. 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, Gulf Coast, \*Magnolia Springs quadrangle.

Shown on the Magnolia Springs topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along Weeks Bay and the northern shore of Bon Secour Bay, along the Fish River to Magnolia River to Magnolia River to Magnolia Springs, Alabama. Many homes and buildings that were constructed at or near the ground level were damaged by floodwater and tidal waves. Many fishing piers along the shores of Mobile Bay and Weeks Bay were damaged. Storm-tide frequency and records of annual maximum tides at Mobile, Ala., since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS) W81-03744

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, BON SECOUR BAY QUADRANGLE, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. J. C. Scott, and L. R. Bohman.

Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geo-logical Survey Hydrologic Investigations Atlas HA-633, 1980. I Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, \*Gulf Coast, \*Bon Secour Bay quadrangle.

Shown on the Bon Secour Bay map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the shore of Bon Secour Bay, generally from Weeks Bay southward to Gasque, Alabama. Most homes along the northern shore of Bon Secour Bay were severely damaged by floodwater and tidal waves. Damage to homes along the southern shore was not as great. Storm-tide frequency and records of annual maximum tides at Mobile, Ala., records of annual maximum tides at Mobile, Ala., since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS)
W81-03745

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, PINE BEACH, ST. ANDREWS BAY, AND FORT MORGAN QUADRANGLES, ALA-BAMA,

BAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. J. C. Scott, and L. R. Bohman. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas HA-634, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-

pheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal floods, "Hurricane Frederic, "Alabama, Gulf Coast, "Pine Beach, "St. Andrews Bay, Fort Morgan, Quadrangles.

Shown on a topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the shores of St. Andrews Bay, Mobile Bay, and Bon Secour Bay from Fort Morgan eastward to about Secont Bay from Fort Morgan eastwart to about four miles east of Gasque, Ala. The storm tide went completely across the land between the beach and Mobile Bay throughout much of the area. Most homes on the beach side of Alabama State Highway 180 were completely destroyed, and the highway was washed out in several places. Damage to homes and other structures on the bay side was not as great. Storm-tide frequency and records of annual maximum tides at Mobile, Ala, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS)
W81-03746

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, GULF SHORES QUADRANGLE, ALA-BAMA.

BAMA, Geological Survey of Alabama, Montgomery. Water Resources Div. J. C. Scott, and L. R. Bohman. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas HA-635, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal \*Hurricane Frederic, \*Alabama, Gulf floods, \*Hurricane Frederic, Coast, \*Gulf Shores quadrangle.

Shown on the Gulf Shores topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the shores of the Gulf of Mexico, Oyster Bay, and the Bon Secour River, in Alabama. Most beachfront homes in the Gulf Alabama. Most bones fronting on Little Lagon in western Gulf Shores were either destroyed or heavily damaged. All beachfront motels were severly damaged. Damage to homes and other buildings in the Oyster Bay-Bon Secour area was not as great. Storm-tide frequency and records of annual maximum tides at Mobile, Ala., since 1772, are presented. Offshore winds reached about 1772, are presented. Offsnore winds reached adort 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS) W81-03747

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, ORANGE BEACH QUADRANGLE, AL-

Geological Survey of Alabama, Montgomery. Water Resources Div.

Water Resources Div.
J. C. Scott, and L. R. Bohman.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas
HA-636, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-sters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \* Coast, \*Orange Beach quadrangle. \*Alabama, Gulf

Shown on the Orange Beach topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the shores of Wolf Bay, Perdido Bay, and Bayou St. John and adjacent areas in the vicinity of Orange Beach, Ala., and along the beaches exposed to the Gulf of Mexico, from Romar Beach, Ala., eastward to Perdido Key, in

Florida. Damage from wind and tidal waves was widespread. The greatest damage occurred along Perdido Key in Alabama and Florida where many homes were destroyed and the highway was washed out in several places. Storm-tide frequency and records of annual maximum tides at Mobile, Ala., since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS)

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, LILLIAN QUADRANGLE, ALABAMA, Geological Survey of Alabama, Montgomery. Water Resources Div.

Water Resources Div.
J. C. Scott, and L. R. Bohman.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas
HA-637, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Alabama, \*Florida, Caste Caste Alabama, \*Florida, Caste Caste Alabama, \*Florida, Caste Ca Gulf Coast, \*Lillian quadrangle.

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the Perdido River and Perdido Bay in the vicinity of the Alabama-Florida State line. Most of the damage in this area was due to minor flooding and damage in this area was due to minor flooding and high winds. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) W81-03749

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, PERDIDO BAY QUADRANGLE,

COAST, PERDIDO BAY QUADRANGLE, FLORIDA,
Geological Survey of Alabama, Montgomery.
Water Resources Div.
J. C. Scott, and M. A. Franklin.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas HA-638, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea levels, Shores, Tidal floods, \*Hurricane Frederic, \*Florida, \*Ala-bama, Guif Coast, \*Perdido Bay quadrangle.

Shown on a topographic map are floodmark eleva-tions and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the southern shore of Perdido Bay, Ono Island in Old River, and Perdido Key exposed to the Gulf of Mexico. The most severe damage occurred along Perdido Key in Alabama and Florida where many Perdido Key in Alabama and Florida where many homes were demolished and the highway was washed out in several places. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) W81-03750

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, WEST PENSACOLA QUADRANGLE, FLORIDA, Geological Survey, Tallahassee, FL. Water Re-

sources Div.

M. A. Franklin, and L. R. Bohman. Available from the Br. of Dist., USGS 1200 S. Eads St. Arlington, VA. 22202, Price: \$1.75. Geo-logical Survey Hydrologic Investigations Atlas HA-639, 1980. I Sheet, 4 Fig. 1 Tab.

# Structures-Group 8A

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Florida, \*Alabama, Gulf Coast, \*West Pensacola quadrangle.

Shown on the West Pensacola topographic map are floodmarks elevations left by Hurricane Frederic tides of September 12-13, 1979, along the eastern shore of Perdido Bay in the vicinity of West Pensacola, Florida. Most of the damage in this area was due to minor flooding and high winds. Still water elevations ranged from about 5 feet above National Geodetic Vertical Datum in the sheltered areas to about 7.5 feet in areas subject to wind setup. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) Alabama. (USGS) W81-03751

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, GULF BREEZE-FORT BARRANCAS QUADRANGLES, FLORIDA, Geological Survey, Tallahassee, FL. Water Re-

sources Div.

Sources Div.
M. A. Franklin, and J. C. Scott.
Available from the Br. of Dist., USGS 1200 S.
Eads St. Arlington, VA. 22202, Price: \$1.75. Geological Survey Hydrologic Investigations Atlas HA-640, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Disasters, Waves, Water-level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Florida, \*Alabama, Gulf Coach \*Gulf Press Fast Bergers Gulf Coast, \*Gulf Breeze-Fort Barrancas quadran-

Shown on the Gulf Breeze-Fort Barrancas topo-Shown on the Gulf Breeze-Fort Barrancas topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the shores of Big Lagoon, Pensacola Bay, Santa Rosa Sound, and the Gulf of Mexico from Seaglades eastward to Pensacola Beach, Florida. The still water elevations ranged from about 5 feet above National Geodetic Vertical Datum in sheltered areas to about 7.5 feet in areas subject to wind setup. Storm-tide frequency and records of annual maximum tides at Mobile, Alabama, since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of shout 145 miles per per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Alabama. (USGS) W81-03752

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12-13, 1979, ALONG THE GULF COAST, ORIOLE BEACH, GARCON POINT, HOLLEY, SOUTH OF HOLLEY, AND NA-VARRE QUADRANGLES, FLORIDA, Geological Survey, Tallahassee, FL. Water Re-sources Div.

sources Div.

sources Div.

M. A. Franklin, and L. R. Bohman.

Available from the Br. of Dist., USGS 1200 S.

Eads St. Arlington, VA. 22202, Price: \$2.00. Geological Survey Hydrologic Investigations Atlas

HA-641, 1980. 1 Sheet, 4 Fig, 1 Tab.

Descriptors: \*Maps, \*Hurricanes, \*Floods, Flood damage, Storm tides, Coasts, Tidal effects, Atmos-pheric pressure, Rain, Surges, Wind velocity, Dis-asters, Waves, Water level, Sea level, Shores, Tidal floods, \*Hurricane Frederic, \*Florida, \*Alabama, Gulf Coast, \*Oriole Beach, Garcon Point, Holley, South of Holley, Navarre, Quadrangles

Shown on the Oriole Beach-Garcon Point-Holley-South of Holley-Navarre, Fla., topographic map are floodmark elevations and approximate areas flooded by Hurricane Frederic tides of September 12-13, 1979, along the shores of Santa Rosa Sound and the Gulf of Mexico from Pensacola Beach eastward to the Narrows near Fort Walton Beach, Fla. Storm-tide frequency and records of annual

maximum tides at Mobile, Ala., since 1772, are presented. Offshore winds reached about 160 miles per hour. A wind-velocity of about 145 miles per hour was recorded near Dauphin Island, Ala. (USGS) W81-03753

INDIANA DRILLER DEVELOPS COMPUTER-IZED WELL LOGS. Water Well Journal, Vol 34, No 8, p 44-46, August, 1980. 1 Fig.

Descriptors: \*Automation, Well drilling, \*Well data, Computer applications, \*Drilling, Data processing, \*Well logs, Drillers logs, \*Indiana.

When an Indiana well drilling company bought a computer, the company managers decided to computerize the reporting of well geological data to the state. A form was developed which was acceptable to both the company and state officials. The form is a single 8 1/2 by 11 sheet which includes the location of the well, driving directions includes the location of the well, driving directions to the site, name of the owner or contractor, name of the drilling equipment operator, depth of the well, type of well, use of well, method of drilling, bailer and pump tests, etc. Data collection begins with the generation of the job order form on the computer. Additional information is added as it is collected. After the job is billed, the information is sent to the state and county governments. The program has reduced the amount of time required to produce the logs. The company has also recently developed an automated vehicle maintenance program which includes depreciation schedules. (Small-FRC) program whi (Small-FRC) W81-03886

COMPUTERIZING BREAKDOWNS MAY IMPROVE WASTEWATER TREATMENT EQUIP-

MENT, Weston Designers-Consultants, West Chester, PA. S. A. Lubetkin. Water and Wastes Engineering, Vol 17, No 3, p

26-27, March, 1980.

\*Computers, \*Data Descriptors: Data processing, Design criteria, \*Equipment, Engineering, Design criteria, Wastewater treatment, Information retrieval, Legal aspects.

Storing equipment breakdown data in computers may help engineers identify manufacturers and models to avoid in designing treatment plants. By law (PL 92-500) an engineer must specify the lowest cost 'equal' equipment. If another choice is preferred, the decision must be defended at the expense of time and legal costs. As a result, the public, who pays for municipal facilities, must tolerate inferior equipment and bear the cost and inconvenience of breakdowns. The author suggests that the EPA serve as a central agency to collect, store, and retrieve information on complaints, list-ing manufacturers name and model of equipment. This makes it possible to spot troublesome equip-ment, and it would encourage manufacturers to provide maintenance on older installations. provide maintenance on (Cassar-FRC) W81-03946

# 8. ENGINEERING WORKS

# 8A. Structures

DITCH WATER CLEANING APPARATUS.

J. D. Naffziger. U.S. Patent No 4,214,988, 6 p, 3 Fig, 3 Ref. Official Gazette of the United States Patent Office, Vol 996, No 5, p 1791, July 29, 1980.

Descriptors: \*Patents, \*Channel flow, \*Channel improvement, \*Equipment, Trash racks, Cleaning, Screens, Irrigation canals, Irrigation ditches.

This invention relates to an improved ditch water cleaning apparatus characterized by a partially covered open ended frame for insertion into the ditch. An upwardly and rearwardly inclined screen at the upstream end of the frame interrupts the

flow of water within the ditch and screens the debris. A propeller-like brush journalled for rota-tion about an axis normal to the plane of the screen is located so that each arm of the brush successively sweeps the surface of the screen and removes any debris onto the covered portion of the frame lying immediately behind. A brush drive means is operatively connected to the brush. The unit also bristles a comb to pick the debris from the brush bristles preparatory to its moving onto the screen. (Sinha-OEIS) W81-03696

APPARATUS FOR CLEANING A SCREEN DIS-POSED IN A WATER CHANNEL.

Schreiber G.m.b.H. and Co. KG, Langenhagen

Schreiber G.m.b.H. and Co. R.G., Langennagen (Germany, F.R.). S. Rudolph, and J. Noring. U.S. Patent No 4,214,989, 9 p, 6 Fig. 10 Ref; Official Gazette of the United States Patent Office, Vol 996, No 5, p 1791-1792, July 29, 1980.

Descriptors: \*Patents, \*Channel flow, \*Channel improvement, Equipment, Trash racks, Screens, Cleaning.

The object of the invention is to provide an apparatus of the general type for cleaning screens located in water channels, but which is simple to assemble, will not encounter operational difficulties known before, and which will not be costly to produce. A rake arm is formed as a single elongated element which is mounted to be supported by, and movable along, the guide track in a cantilever fashion, so that only one vertical supporting frame need be employed for the entire apparatus. A connecting means extends from the rake arm to a count on troop of a supporting surface of the guide. point on top of a supporting surface of the guide track and the center of gravity of the connecting means is maintained at a point supported by the guide track due to the endless chain which is guide track due to the endiess chain which is connected to the connecting means adjacent the end opposite to the end pivotally connected to the rake arm. A supporting roll is positioned so that its longitudinal central vertical plane is located at a point along the supporting surface of the guide track. (Sinha-OEIS)

LOWER KHALIS IRRIGATION PROJECT -

IRAQ, ICI Fibers (England). I. R. Clough. Aqua, No 9/10, p 18-19, 1980.

Descriptors: \*Irrigation programs, \*Land reclama-tion, \*Desalination, Drainage systems, \*Iraq, Fil-ters, Fabrics, Tigris River, Euphrates River, Khalis, \*Demineralization.

The Government of Iraq has begun in recent years an ambitious program to reclaim the once fertile land near the Tigris and Euphrates Rivers. Salt deposited on that land by the flooding of these rivers over the centuries has left the land useless for crops. Drainage systems are being installed to desalinate the soil, and modern methods of irrigation are also being employed. The Lower Khalis project, one of the major projects in the system, is described. Using modern technology, a total of 7,500 km of field-drains are being installed over a 5 by period. Field drains are being instance over a y yr period. Field drains make it possible to wash salt from the soil in an initial leaching program, they maintain soil salinity at a level for optimum crop production, and they ensure that the root zone of production, and they ensure that the root zone of the crops remains aerated and cannot become waterlogged. There is a gravel filter surrounding the field drain which increases the effective diameter of the drain and prevents the more unstable soils from entering and blocking the pipe. The use of a fabric filter is detailed. A particular fabric, Terram 140, was designed specifically for this use and appears to increase the efficiency of the system without fear of soil siltation or filter failure. (Baker-FRC) W81-03915

WELL SOLVES WATER SHORTAGE, PRE-SERVES SCENIC RIVER,

#### Field 8—ENGINEERING WORKS

# Group 8A-Structures

Hammond, Collier and Wade-Livingstone Asso-T. Luebke, and C. L. Cowden.

Water and Wastes Engineering, Vol 17, No 6, p

40-41. June, 1980. 2 Fig.

Descriptors: \*Municipal water, \*Wells, Water shortage, Water conveyance, Rivers, Marysville, \*Washington, Water supply, Planning.

A sudden water shortage emergency in 1977 created a need for the City of Marysville, Washington, to satisfy an immediate deficit of 3.2 million gallons per day (Mgd). At the same time, the city gallons per day (Mgd). At the same time, the city needed to plan for a projected 80% increase in the water service area population by 1990. Previous studies had indicated that a 16 Mgd Ramey-type collector well was the most acceptable design alternative. In order to receive Drought Relief Aid from the Economic Development Administration, the project had to be compleed in 9 months. To satisfy criteria imposed by the State and by the Snohomish County Shorelines Hearing Board, the top of the well caisson had to be placed 15 feet below the 100-year flood level of the Stillaguamish River, from which the under-river well would collect water. The underground control housing was designed so that the top hatches are just above the 100-year flood level, and the controls were the 100-year flood level, and the controls were installed 750 feet away at a higher elevation. The instance 750 feet away at a ingine elevation. The units are unobtrusive and require no disturbance of nearby trees. The well caisson is visible only during periods of extremely low water. The concrete well caisson now contains two submersible crete well caisson now contains two submersible turbine pumps capable of pumping enough water to meet the drought deficiency and enough space for three additional pumps to be included as needed to meet the increasing demands of the population. Water is drawn into the well caisson through seven 100-foot long screens which filter the water as it is collected for pumping to the city's reservoirs. The entire facility is monitored at a central panel in the city, 12 miles away. (Carroll-FRC) W81-03933

# 8B. Hydraulics

CURRENT STATUS OF COMBINED SEWER PROBLEMS AND THEIR CONTROL MEAS-URES IN JAPAN,

Works Research Inst., Tokyo (Japan). Water Quality Control Div.
For primary bibliographic entry see Field 5B.
W81-03616

PHYSICAL MODEL STUDIES OF HEAD-DIS-CHARGE RELATIONSHIPS FOR STEEL Z-SECTION WATER-LEVEL CONTROL STRUC-

Science and Education Administration, Stillwater,

OK. Water Conservation Structures Lab.
C. E. Rice, and W. R. Gwinn.
Agricultural Reviews and Manuals ARM-S-16,
May, 1981. 22 p, 18 Fig, 3 Tab, 7 Ref.

Descriptors: \*Hydraulic models, \*Weirs, \*Flow discharge, Model studies, Water level, Watersheds, Hydraulic structures, Flow control, Upstream, \*Okeechobee County, Florida.

Structures S-13 and S-13B are water-level control structures constructed with section MZ 27 steel sheet pilings at the outlet and upstream of the outlet of a watershed sub-unit in Okeechobee outlet of a watershed sub-unit in Okechobee County, Florida. Rectangular-weir data cannot be used to predict the discharge for multiple-oblique weirs of this type. Model experiments were conducted in a 10 by 40 ft test basin, using z-section structures made to scale from field measurements. An equation developed by Villemonte from a series of tests on submerged sharp-crested weirs referred to the submerged discharge countries. adequately predicted the submerged discharge. The approach conditions immediately upstream of the weir had a significant effect on the head-discharge relationship. The elevation there should be 0.5 ft or more lower than the weir-crest eleva-tion to ensure that the structure will control the flow, with the discharge being little affected by surface roughness. The head-discharge relationship for structure S-13B, with a 9 ft weir-opening width, was adequately predicted using the dis-charge coefficients calculated for structure S-13, with 15 ft weir-opening width. (Moore-SRC)

# 8C. Hydraulic Machinery

HEAT-POWDERED WATER PUMP, Utah State Univ. Foundation, Logan. (Assignee). D. G. Chadwick. U.S. Patent No 4,212,593, 6 p, 1 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 996, No 3, p 958, July 15, 1980.

Descriptors: \*Patents, \*Pumps, \*Water conveyance, Thermal power, Vapor pressure, Evaporators. Solar radiation.

A heat-powered water pump is relatively simple in construction and readily adaptable to inexpensive-ly pump water at a remote location with a minimal amount of maintenance and/or monitoring. Either amount of maintenance and/or monitoring. Either solar energy or the combustion of agricultural wastes may be used to supply thermal energy to vaporize a metered quantity of volatile liquid in an evaporator. The vapor thus produced is delivered to a pumping chamber where it expands and pushes downwardly on the liquid surface thereby expelling water from the adjacent reservoir through a check valve. Condensation of the vapor through a check valve. Condensation of the vapor produces a partial vacuum in the pumping chamber closing the outlet check valve and opening an inlet check valve immersed in a water source thereby causing the reservoir to refill and the liquid level in the pumping chamber to again rise. The rising level of liquid in the pumping chamber refills a metering cup so that a siphon tube cyclically drains the metering cup and delivers metered volatile liquid to the evaporator for repeating the numning cycle. The evaporator stores sufficient volatile liquid to the evaporator for repeating the pumping cycle. The evaporator stores sufficient thermal energy between stages to evaporate the metered volatile liquid. The working fluid includes a volatile liquid that is less dense than water and also immiscible with water or the working fluid for the pump may be supplied from the water being pumped. (Sinha-OEIS) W81-03674

HOW SAFE ARE YOUR SEWAGE WET

R. H. Carpenter, and L. Cass. Water and Wastes Engineering, Vol 17, No 6, p 16-18, 21, June, 1980.

Descriptors: \*Pumps, \*Wastewater treatment, \*Hazards, Safety, Explosions, Electrical equipment. Standards

The wastewater treatment industry is involved in a controversy regarding the need for explosion-proof submersible sewage pump motor requirements in sewage wet wells. Various governmental and private organizations have classified sewage wet wells as Class 1, Division 1, Hazardous Locations. The National Electrical Code (NEC) defines were the service of the control such a location as one in which electrical equip-ment is used and in which hazardous concentra-tions of flammable gases or vapors may be present under normal operating conditions. Although sev-eral manufacturers of submersible sewage pumps and their motors and numerous consulting engineers agree with this classification, other pump manufacturers, speaking through the Submersible Wastewater Pump Association (SWPA), disagree. Neither the NEC nor the Occupational Safety and Health Administration requires the use of explo-sion-proof equipment. However, they do require the use of equipment certified for use in the speci-fied location classification. Underwriters Laboratories, which provdes such certification, only lists explosion-proof submersible sewage pump motors for Class 1, Division 1, Hazardous Locations. SWPA contends that redundant low-level cutoff controls should be accepted in lieu of explosion-proof motors. However, these controls do little to prevent the machines from being exposed to the hazardous atmosphere of the wet well. In addition, explosions of non-explosion-proof submersible pumps while the pumps were submerged have

been reported in four locations. Lobbying efforts by SWPA to have sewage wet wells reclassified are considered inappropriate and unsound by many pump manufacturing companies. (Carroll-FRC) W81-03937

#### 8G. Materials

ASSESSMENT OF LINER MATERIALS FOR MUNICIPAL SOLID WASTE LANDFILLS, Matrecon, Inc., Oakland, CA.

M. A. Fong, and H. E. Haxo, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PBB-1-73874, Price codes: Al2 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, PA. Shultz, D. W., Ed., EPA Report EPA-600/9-81-002a, March, 1981, p 138-162. 7 Fig. 11 Tab, 9 Ref, 68-03-2134.

Descriptors: \*Landfills, \*Impervious membranes, \*Leachates, \*Solid waste disposal, Municipal wastes, Water pollution prevention, Polymers, Asphaltic concrete, Soil cement, Permeability, Physi-

The results of the effects of exposure of 12 lining materials for 56 months to municipal solid waste (MSW) leachate under conditions designed to simulate those that exist at the bottom of a MSW landfill are presented and discussed. The liner mainancini are presented and cuscussed. The liner materials used were four admix materials, two asphaltic membranes, and six flexible polymeric membranes. The 56 months of exposure to the leachate did not increase the permeability of any of the liners. However, the exposure resulted in losses in the compressive strength of the admix liner materiate. the compressive strength of the admix liner materials and in the softening of the asphaltic materials. It also resulted swelling of most of the polymeric membranes and in losses in the physical properties of some of the membranes: Several seams lost strength, but the heat-sealed seams, as a group, retained their strength best. Among the flexible membranes, the low-density polyethylene, a partially crystalline polymer, sustained the least change during the exposure period; however, the low-density polyethylene membrane was thin and change during ine exposure period; noweer, the low-density polyethylene membrane was thin and susceptible to easy puncturing and tearing which could cause problems during installation and prob-ably cause problems during service under most conditions. The thermoplastic membranes - chlor-inated polyethylene and chlorosulfonated polyethylene - tended to swell most. The vulcanized rub-bery liner materials - butyl and ethylene propylene bery inter materials outyl and ethylene propylene rubber - changed little during the exposure period, but had the lowest initial seam strength. A complete immersion test of 28 different polymeric membrane liner materials in MSW landfill leachate memorane liner materials in MSW installin learning for 31 months showed that changes in properties were generally related to the amount of swell undergone by the membranes. (Brambley-SRC) W81-03637

FIELD VERIFICATION OF LINERS; ASSESSMENT OF LONG-TERM EXPOSED LINER MATERIALS FROM MUNICIPAL SOLID WASTE LANDFILLS, EMCON Associates, San Jose, CA. J. G. Pacey, C. G. Brisley, Jr., and R. L. Dooley. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173874, Price codes: Al 2 in paper copy, A01 in microfiche. In: Land Disposal: Municipal Solid Waste, Proceedings of the Seventh Annual Research Symposium, March 16-18, 1981, Philadelphia, PA. Shultz, D. W. Ed. Environmental Protection Aseas D. W., Ed., Environmental Protection Agency Report EPA-600/9-81-002a, March, 1981, p 163-169. 2 Fig.

Descriptors: \*Landfills, \*Impervious membranes, \*Leachates, \*Field tests, Solid waste disposal, Municipal wastes, Sampling, Permeability, Soil chemistry, Soil analysis, Legal aspects, Clays, Polymers, Asphalt.

The physical and chemical conditions of clay, asphalt, and PVC liners subjected to continued long-term exposure of leachate and decomposing refuse are being studied. Four sites have been selected, and based on site visits and further information, the sampling and repair methodology was developed. Sampling methods were developed for clay, asphalt and PVC linings, with particular emphasis on the sealing of the penetrated lining after removal of the sampling devices. Tests to be conducted on the liners include those to determine permeability, thickness, tensile strength, hardness, tear strength, creep, water absorption, puncture resistance, swelling, compressive strength and viscosity. Some of these tests will also be conducted on soil from below the liners, and it will be analyzed chemically. Because of legal and financial concerns of owners, operators, consultants and contractors, only two sites have been tested to date, and it is considered that these concerns must be addressed before successful cooperation can be obtained. (Brambley-SRC)

WOOD STAVE TANKS ARE MEMBRANE LINED FOR CHEMICAL STORAGE AT LORNE PARK WATER PURIFICATION PLANT.

For primary bibliographic entry see Field 5G. W81-03901

# 81. Fisheries Engineering

ATTEMPT TO APPLY A MODEL FOR STUDY-ING FISHERIES IN INTERTROPICAL FLOOD PLAINS AT LAKE ALAOTRA (MADAGAS-CAR). (ESSAI D'APPLICATION AU LAC ALAOTRA (MADAGASCAR) D'UN MODELE D'ETUDE DES PECHERIES POUR LES PLAINES D'INONDATION INTERTROPI-CALES),

Ecole National Superieure Agronomique de Toulouse (France). Lab. de Ichtyologie Appliquee. J. Moreau.

Cahiers O.R.S.T.O.M., Serie Hydrobiologie, Vol 13, No 1/2, p 83-91, 1979-1980. 5 Fig, 5 Tab, 6 Ref.

Descriptors: \*Lakes, \*Fisheries, Land use, Planning, Lake Alaotra, Madagascar, Tropical regions, Population dynamics, Model studies, Flood plains.

A previously developed model which describes the fish populations and fisheries of African flood plains was applied to Lake Alaotra and its fisheries. The biology of the fish, the demographic structers and the effective force in the medium are the most sensitive differences from the model. Field work showed that the best results are obtained by studying the practical aspects of fisheries and the actual catch. The development of rice-field cultivation near the lake will probably cause a decrease in the fish harvest within a few years. A study of the surface variations between the high and low water marks showed that management of the rice fields in the past 20 years has damaged the neighboring marshes, which covered 60,000 ha in 1960 but only 35,000 ha by 1976. Also, the lake was a victim of mechanical pollution connected with human activities, and there was a progressive reduction of the surface of the marshes after agricultural use. Thus, authorities face a choice between increased rice production and decreased fish production or maintenance of an equilibrium between the two. (Hertzoff-FRC)

# 9. MANPOWER, GRANTS AND FACILITIES

# 9D. Grants, Contracts, and Research Act Allotments

CONSTRUCTION GRANTS' PROCEDURES FLOW CHART EXPLAINED, ESEI, Detroit, MI. J. Grieshaber, and L. Katz. Water and Sewage Works, Vol 127, No 11, p 34, November, 1980. 1 Fig. Descriptors: \*Construction, \*Grants, Clean Water Act, Federal government, Wastewater treatment, Financing, Economics, Construction costs, State government. Legislation.

A revised procedures flow chart is presented to be used in aiding grant applicants and consultants through the maze of regulatory requirements involved in attempting to follow the requirements of the Clean Water Act of 1977. This revised flow chart reflects the changes to be found in the second edition of the Handbook of Procedures, issued in February of 1976. The major new element in the program, based on the Clean Water Act of 1977 and other policy changes, is the required consideration of innovative and alternative to conventional treatment and disposal when they are cost-effective. An overall thrust of the program is the movement toward increased delegation of review functions to state agencies having the necessary resources to competently administer the program. (Baker-FRC)

# 10. SCIENTIFIC AND TECHNICAL INFORMATION

## 10F. Preparation Of Reviews

UNCERTAINTIES IN ESTIMATING THE WATER BALANCE OF LAKES, Geological Survey, Lakewood, CO. For primary bibliographic entry see Field 2H. W81-03782



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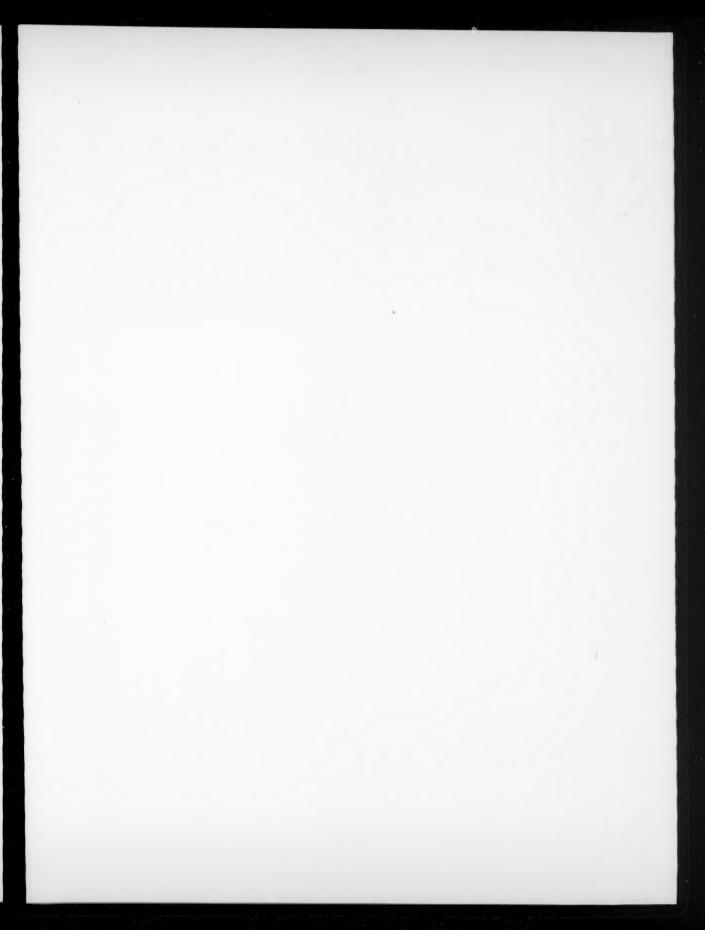
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